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Seattle, Washington

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Phase II Transformer PCB Investigation Report

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List of Abbreviations and Acronyms

Acronym	Definition
bml	Below mudline (used for sediment samples)
bgs	Below ground surface (used for uplands samples)
CSL	Cleanup screening level (under SMS)
CSM	Conceptual Site Model
DO	Dissolved oxygen
DNAPL	Dense non-aqueous phase liquid
DSOA	Duwamish Sediment Other Area
GE	General Electric
ID	Inside diameter
IDW	Inverse Distance Weighted
IM	Interim measure
KCIA	King County International Airport
LAET	Lowest apparent effects threshold
LNAPL	Light non-aqueous phase liquid
NOAA	National Oceanic and Atmospheric Administration
MLLW	Mean Lower Low Water
OA	Other area
OD	Outside diameter
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PID	Photo ionization detector
ppm	Parts per million
ppt	Parts per trillion
psi	Pound per square inch
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation Recovery Act
RFI	RCRA Facility Investigation
SCL	Seattle City Light
SDMH	Storm drain manhole
SMS	Washington State Sediment Management Standards

SOPs	Standard operating procedures
TCE	Trichloroethylene
TOC	Total organic carbon
TPH	Total petroleum hydrocarbon
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1.0 Introduction

This report addresses the analysis and reporting requirements for the *Phase II Transformer PCB Investigation Work Plan* (Phase II Work Plan; Floyd|Snider et al. 2004) implemented under the Administrative Order on Consent (Order) issued by the U.S. Environmental Protection Agency (USEPA) to The Boeing Company (Boeing) under the authority of Section 3008(h) of the Resource Conservation and Recovery Act of 1976 (RCRA), as amended, 42 USC 6928(h). This Order [RCRA Docket No. 1092-01-22-3008(h)] became effective on January 18, 1994. The Order specified activities necessary to correct or evaluate actual or potential threats to human health and the environment resulting from the release or potential release of hazardous constituents from or at the Boeing Plant 2 Facility (the Facility) located at 7755 East Marginal Way South, Seattle, Washington (Figure 1.1).

1.1 BACKGROUND

In August 2001, Boeing was installing secondary containment curbing around the West Bank electrical substation located adjacent to the southern border of the Facility (transformer equipment owned and operated by Seattle City Light [SCL]). This involved the removal of existing concrete and incidental soil. A hydrocarbon odor was noted in a sandy silt layer in soil approximately 10 to 18 inches below ground surface (bgs) beneath a removed section of concrete. Soil samples were collected and submitted for analysis of polychlorinated biphenyls (PCBs) and other constituents[1]. The initial screening results indicated relatively high levels of PCBs in the soil underlying the area. Based on these results, Boeing excavated an area measuring approximately 6 feet by 10 feet by 3 feet deep (approximately 7 cubic yards) to remove contaminated soil and to further define the extent of PCBs. Analyses of samples collected from the sidewalls and bottom of the excavation (termed the "Area of Discovery") revealed variable PCB concentrations ranging from non-detect up to 460,000 µg/kg (taken from a sidewall sample along the western property line. To confirm the presence of PCBs, additional samples were collected adjacent to the initial locations but 5 to 6 inches further into the sidewalls and 1 foot below the excavation bottom. Generally, concentrations in these deeper samples were significantly less than the initial sample concentrations, which indicates a variable contaminant distribution across small distances.

Boeing interrupted the containment construction project, brought the issue to the attention of the USEPA, and paved the Area of Discovery excavation to prevent human contact and surface water infiltration (pending resolution of the extent and source of the PCB contamination). In a letter dated May 23, 2002, USEPA directed Boeing to conduct a further investigation to characterize the extent of the release (Sikorski 2002). USEPA required Boeing to:

- Characterize the hydrogeologic regime underlying the Area of Discovery in sufficient detail to evaluate the nature and extent of the release from the transformer(s).
- Gather data to make decisions on stabilization as needed; that is, to evaluate whether immediate action is necessary to prevent further spread of contamination or to protect human health and the environment.

[1] Sampling and analysis of soil samples for waste disposition purposes is a routine step for all excavations as part of construction activities at the Facility.

- Characterize concentrations, rates and directions of movement, chemical nature, and extent of contamination in any environmental medium off-site or on-site, including sediment in the Duwamish Waterway that may have been impacted by this release.
- Identify potential human and ecological receptors to hazardous constituents at or from the Facility associated with this release.
- Support the development and analysis of corrective measure alternatives for this release.

In order to address these requirements, a Phase I Work Plan (Weston 2003) and Phase I Report (FSM 2004) were prepared by Boeing and approved by USEPA. The Phase I Report identified several data gaps in the understanding of the mechanism for how the PCBs were released into the environment and the pathways in which they are potentially being transported to receptors. Subsequently, the Phase II Work Plan was prepared to fill these data gaps (Floyd|Snider et al. 2004). The Work Plan was approved by USEPA in February 2005 and subsequently implemented by Boeing. This report, in addition to reporting the results of the Phase II field activities, interprets and discusses the entire data set available for the broader investigation area, including Phase I and Phase II data, RCRA Facility Investigation (RFI) data, and pertinent data from that portion of the Southwest Bank downgradient of the Area of Discovery. The Southwest Bank area is a section of the waterway bank extending from the southern property border of Plant 2 north, approximately 300 feet to the 2-49 Building. The Southwest Bank has been the focus of numerous environmental investigations unrelated to this investigation (refer to Section 1.2.3).

The four transformers at the former West Bank substation (substation) were drained of their fluid and removed by SCL in the spring of 2004. Details on the decommissioning of the transformers, including results of sampling of the dielectric fluid, wipe samples from the transformer exteriors, and the concrete pad underlying the transformers are contained in Appendix D of the Phase II Work Plan (Floyd|Snider et al. 2004).

1.2 PREVIOUS STUDIES

Numerous environmental investigations were conducted in the southern portion of the Facility since the late 1980s. The following sections describe the most significant prior investigations that were conducted in the vicinity of the substation.

1.2.1 RCRA Facility Investigation

The substation lies within a previously identified area of subsurface contamination referred to in the RFI as Other Area (OA) 11 (Weston 1996, 1997). Soil samples collected from soil borings in the vicinity of the substation were analyzed for PCBs as part of the OA 11 investigation (Weston 1998). PCBs were detected at concentrations ranging from 26 µg/kg to 22,000 µg/kg (total of all Aroclors detected). The highest PCB concentrations were detected in the sample intervals from 1 to 6 feet bgs in borings within 50 feet of the Area of Discovery.

Seven monitoring wells were installed within 100 feet of the substation both prior to and during the RFI as part of the ongoing characterization in the area. Of these seven wells, PCBs were

only detected in one of them, a pre-RFI well (PL2-006A) immediately downgradient of the substation pad, at a maximum concentration of 8.9 µg/L in 1995 (Weston 1997).

1.2.2 2-66 Sheetpile Interim Measures

A sheetpile containment structure was constructed in 1993 as an interim measure (IM) around the former aboveground trichloroethylene (TCE) storage tank and associated underground piping near former Building 2-66. The southeastern edge of the 2-66 containment structure is roughly 100 feet north of the substation pad. The purpose of the sheetpile structure is to contain elevated concentrations of TCE and its degradation products in groundwater and soil. Beginning in 2003, another IM was implemented to remove the solvents inside the sheetpile using a soil vapor extraction and groundwater recirculation system. Thirty monitoring wells are present in the vicinity of the 2-66 containment structure. An additional evaluation of the groundwater conditions at the sheetpile is being conducted as part of the ongoing IM. Although PCBs were not specifically analyzed as part of these IMs, soil samples were collected during the RFI from two borings that turned out to be located within the sheetpile. PCBs were not detected in the nine of samples analyzed.

1.2.3 Southwest Bank Corrective Measure Study

The Southwest Bank is a section of shoreline at the southern end of the Facility fronting on the Duwamish Waterway that, at its closest, is approximately 250 feet west of the substation. During the RFI, soil and bank samples indicated the presence of an elevated concentration of heavy metals (primarily cadmium, copper, lead, and zinc) and PCBs mainly associated with construction debris used to fill the bank over time. In 2000, Boeing proposed a corrective measure that would involve reconstruction of the Southwest Bank. The proposed corrective measure, to be done concurrent with the dredging of the Duwamish Sediment Other Area (DSOA), would involve excavation, re-grading, and capping of a portion of the bank. The benefit of the bank reconstruction would be to stabilize the bank and remove the contaminated debris that could potentially re-contaminate the sediments in the waterway following DSOA dredging (Pentec et al. 2002).

In 2001, a series of 21 soil borings were drilled in seven transects perpendicular to the bank (Pentec et al. 2001a) in order to obtain additional data for the design of the corrective measure. The samples from the borings confirmed presence of construction debris, riprap, and associated contaminated materials. While PCBs were detected in the bank debris layer in several of the soil boring samples, the samples from borings along transects closest to the transformer area did not have PCB levels detected in the native or construction fill underlying the bank debris. This is consistent with other locations in the Southwest Bank where PCBs appear associated with the debris layer and not with underlying soils or groundwater.

1.2.4 DSOA Characterization

The sediment downstream of the Transformer Investigation Area (i.e., the broader area surrounding and downgradient of the substation that could conceivably be a source of or affected by the PCB release) was sampled as part of the DSOA investigation (Pentec et al. 2001b). Six sediment core locations were sampled between Outfall 12 and the southern

boundary of the DSOA directly in front of the Southwest Bank. The results of this sampling are incorporated into the broader discussion of PCB contamination in waterway sediments as presented in Section 4.6.

1.2.5 Phase I Transformer Investigation

The Phase I Transformer PCB Investigation characterized the extent of the PCB release in soil and groundwater in the vicinity of the substation and sediment in front of storm system outfalls that drained or transited the Transformer Investigation Area. A summary of Phase I findings for the uplands (soil and groundwater) and sediment offshore of the outfalls is discussed below.

Uplands Phase I Summary

A total of 180 soil samples were collected and analyzed for PCBs. PCB concentrations ranged from non-detect to 660,000 µg/kg. The highest concentrations were located in or under the Area of Discovery. PCB concentrations decreased laterally with distance from the Area of Discovery and were not detected at concentrations greater than 1,000 µg/kg in borings located more than 80 feet from the Area of Discovery. PCB concentrations were all less than 1,000 µg/kg in samples collected below a depth of 14 feet bgs.

In addition, four groundwater wells were sampled. PCBs were detected at a concentration of 0.41 µg/L in the groundwater sample collected from Well PL2-006A, which was abandoned as part of Phase II activities. This well is screened across a soil zone near the water table containing PCBs at a concentration of 6,000 µg/kg. PCBs were not detected in Well PL2-007A, which is located downgradient of Well PL2-006A nor, in Wells PL2-JF01AR and PL2-JF02A located further southwest from the Area of Discovery.

Sediment Phase I Summary

Sediment in front of the Southwest Bank and Boeing Outfalls 9/9A were sufficiently characterized in previous investigations of the DSOA; therefore, sediment samples collected as part of Phase I activities were located upriver of the current DSOA boundary. Samples were collected in the nearshore area at the bend in the waterway, approximately 200 feet west of the substation where two parallel stormwater pipes (nominal 12-inch and 24-inch inside diameter [ID]) transit on the Jorgensen Forge side of the Plant 2-Jorgensen Forge property line. These pipes (termed the "Property Line Storm Pipes") discharge to two outfalls, located at the bend in the waterway.

The Phase I results indicate Washington State Sediment Management Standards (SMS) Cleanup Screening Levels (CSL; WAC 173-204-520) exceedances for PCBs in sediment at all sample stations. CSL exceedances at several nearshore stations (SD-DUW161, SD-DUW163, and SD-DW165) were limited to the upper 2 feet of sediment below mudline (bml). These stations also had a sandy substrate with very low carbon content. Consistent with state guidance, the low-carbon samples were compared to the second lowest apparent effects threshold values (LAET), which are not carbon-normalized, to determine the CSL exceedances. Cores located further away from the shore encountered a more silty substrate with a higher

organic carbon content. In these cores, concentrations generally exceeded the CSL to at least 4 feet bml.

Phase I results indicate that the highest PCB concentrations occur in the 0- to 1-foot interval in front of both Outfalls 9/9A and the Property Line Outfalls. The vertical extent of PCBs greater than CSL was fully established with depth at most sediment core stations. Bank surface samples (approximately the top 10 cm) collected in front of the Property Line Outfalls showed significant PCB contamination as well.

The Phase I data, when combined with the DSOA data, strongly indicate that PCB contamination is present upriver of the present DSOA boundary including, in front of the Property Line Outfalls and further upriver. The extent of this contamination upriver was not resolved by Phase I work. Subsequently, USEPA directed that additional sampling be conducted as part of Phase II and include sampling stations offshore of the Phase I stations out to the eastern edge of the navigation channel.

Boeing had already been directed by USEPA in 2003 to conduct sediment sampling along an upriver section of the waterway in the vicinity of the Jorgensen Forge. To integrate the two objectives, USEPA staff familiar with the Phase I investigation met with Boeing and identified sample locations that would meet the goals of both the Upriver Investigation (in sediments identified as "Area 1") and the Transformer PCB Investigation. As a result of that meeting, eight cores were to be collected in Area 1 by Boeing as part of the Phase II Work Plan to determine the extent of PCBs associated with the Transformer Investigation Area.

1.2.6 Phase II Sediment Data Report

Boeing conducted upriver sediment sampling in Area 1 during April 2004 and the data report from that sampling event was submitted to the Agencies in October 2004 (MCS 2004). This report, including the eight cores collected as part of the Phase II Work Plan, is not duplicated here. A summary figure and discussion incorporating the results from these stations is presented in Section 4.6.

1.3 CONCEPTUAL SITE MODEL THROUGH PHASE I RESULTS

Information and analyses from the Phase I Report were used to develop the following conceptual site model (CSM) for the Area of Discovery release found adjacent to the substation.

1.3.1 Releases to Soil, Groundwater, and Surface Water

The primary mechanism for the release of PCBs at the Area of Discovery is thought to be one or more historic surface spills or leaks of PCB-containing fluids at or near the substation. Such spills or leaks contacted surface soils in the Area of Discovery and migrated downward and also laterally to the east and west along preferential pathways. Downward migration occurred until the PCB-containing fluids contacted the groundwater surface. The PCBs then spread laterally, primarily in a downgradient direction. This spreading may have been influenced by commingling with petroleum hydrocarbons (mainly mineral spirits and a heavier oil) present in

elevated concentrations in soil immediately downgradient of the substation and at lesser concentrations across a much wider area including Jorgensen Forge.

The extent of PCBs in soil associated with the Area of Discovery was sufficiently characterized by Phase I work except in the downgradient (west) and upgradient (east) directions, where the concentration contours were still "open" (i.e., unable to be closed due to lack of sufficient outlying non-detect data points). The Phase II investigation was designed to delineate the extent of PCBs in these directions or otherwise identify progressively higher concentrations that might indicate a source originating to the east of the Area of Discovery (which is discussed further in Section 4.0).

Concerning stormwater, the substation area was historically served on its south side by a stormwater collection trough running along the Boeing side of the property line and past the Area of Discovery. This trough, now mostly replaced by concrete curbing, directed sheetflow from pavement or roof drainage from buildings (now removed) as far away as the historical high point of the trough (located approximately 350 feet east of the substation). The trough directed stormwater to a vault located 10 feet west of the substation. This vault, constructed in 1968, is connected to a nearby Boeing storm drain manhole (SDMH) 36-83 that received discharge from the trough as well as several other areas, including the pavement in the general vicinity of the substation.

Prior to 1994, stormwater in the substation area discharged to the waterway via Outfall 9. This outfall was abandoned in 1994 during sheetpile construction at Building 2-66, as described in Section 1.2.2. At that time, stormwater discharging from the manhole was rerouted and tied into the broader South Yard drainage system draining to Outfall 9A.

Given the proximity of the trough to the Area of Discovery, it is likely that PCBs released at or near the substation were transported directly to the waterway via the storm system via Boeing SDMH 36-83. This is supported by elevated PCB concentrations found in the sediment in front of Outfalls 9/9A. The storm system was investigated during Phase II fieldwork as discussed in Sections 3.0 and 4.0 of this report.

Currently, the Area of Discovery is paved, thereby eliminating the potential for stormwater transport of PCBs to the waterway; however, residual contamination could still exist in solids within the storm system catch basins, manholes, and associated piping. If so, the potential was identified for a continued release of PCBs to the waterway. The release mechanism and pathway identified in the Phase I Report was transport of residual PCBs present in storm solids into the larger storm system and/or infiltration of contaminated soil/groundwater into cracks or open joints in the stormwater pipes leading to the Property Line Outfalls or Outfall 9A. Although these stormwater pipes are believed to lie above the typical groundwater surface, the extent to which high tides cause groundwater to rise and contact these stormwater pipes was not established during Phase I activities.

Several questions remained unanswered after Phase 1 activities regarding the current conditions and historical connections of the storm system that were addressed during the Phase II investigation as discussed in Section 4.6

1.3.2 Ecological and Human Health Receptors

The ecological and human health receptors for soil, groundwater, and sediment at the Facility are summarized in the Comprehensive RCRA Facility Investigation Report (Weston 1998).

No direct exposure pathway exists for contaminated soil or groundwater. The upland portion of the Facility is completely paved or covered with buildings (except for small landscape areas) and comprehensive institutional controls are in effect. Therefore, a completed exposure pathway for direct contact with soil is not present and, given the long-term industrial use of the property, will not be present in the future. The pathway involving migration of contaminants from groundwater and soil to indoor air was considered not complete during the RFI process; however, this pathway was reopened in 2001 given new risk considerations. This pathway is not relevant to the Transformer Investigation Area given the non-volatile nature of PCBs and lack of buildings in the area.

Ingestion of groundwater was not identified as a pathway because the groundwater beneath the site is not considered potable and its highest beneficial use is discharge to the Duwamish Waterway (Herman et al. 1998; Pendowski 2000). However, the groundwater beneath the Facility is hydraulically connected to the Duwamish Waterway and leaching and partitioning of constituents in upland soil to groundwater that discharges to surface water is a potential concern. Therefore, the exposure pathways and ecological receptors identified in the soil and groundwater evaluations are based on surface water exposure pathways. Ingestion of fish obtained from the Duwamish Waterway is considered to be a complete exposure pathway for human health evaluation purposes. Fish and benthic invertebrates in the Duwamish Waterway adjacent to the Facility were identified as the primary ecological receptors of concern for the environmental evaluation of soil and groundwater.

The Duwamish Waterway, including the eastern portion of the waterway adjacent to the Facility, is used as fishing grounds by Tribal fishermen. The Duwamish Waterway represents the migratory corridor for adult and juvenile fish into the Green River watershed. The primary receptors of concern identified in the human health and environmental evaluation for sediment are Tribal fisherman, benthic invertebrates, and fish and shellfish populations.

1.3.3 Groundwater Transport

The Phase I results indicated the presence of PCBs in soil at the water table and PCBs in groundwater monitored by Well PL2-006A screened across these soils. However, this pathway was not believed to be transporting PCBs a significant distance away from the substation area. PCBs have an extremely low solubility in water, particularly the heavier Aroclors that were detected in groundwater at this well. PCBs also have a strong affinity for adsorption onto solid phases, especially within the organic content of soil. This results in a significant retardation of PCBs in groundwater. The organic carbon concentration of soil in the Transformer Investigation Area was established during Phase I activities to range from 0.1 to 2 percent. This large fraction of organic matter is sufficient to adsorb significant quantities of PCBs, thereby retarding PCB transport via groundwater.

Because of the presence of total petroleum hydrocarbons (TPH) and solvents downgradient of the substation area, and questions about the groundwater gradient (different studies showed

about a 10 degree variability in flow directions), the groundwater pathway was further evaluated during the Phase II investigation.

1.3.4 Summary of Phase I Findings and Pathways

The following summarizes Phase I soil and groundwater findings.

- Soil concentrations around the substation indicate that PCB concentrations decrease to less than 1,000 µg/kg within 80 feet laterally and within 14 feet vertically from the Area of Discovery.
- PCBs have been detected in samples from Well PL2-006A since at least 1992, yet PCBs have never been detected in groundwater at Well PL2-007A, located 40 feet downgradient.

The CSM in the Phase I Report identified four potential pathways for PCBs to migrate or otherwise be transported to the waterway as follows:

- Historical transport of PCBs from the Area of Discovery directly into the storm system transiting the Area of Discovery and subsequent discharge and partitioning onto sediment in the waterway, specifically via Boeing Outfall 9 (prior to 1994).
- Transport of residual PCBs present in catch basin or manhole solids to sediments in the waterway via the storm piping discharging to Outfall 9/9A.
- Transport of PCBs through soil seepage and groundwater infiltration into the stormwater piping serving the Property Line Outfalls.
- Transport of PCBs dissolved in groundwater, which in turn, discharges to the waterway.

Further investigation into the significance of any of these potential historical or currently active pathways was the focus of the Phase II investigation. The only pathway concluded during Phase I to be blocked (inactive) was the transport of PCBs present in near surface soils in the Area of Discovery directly into the storm system (because the Area of Discovery has been paved).

2.0 Phase II Field Investigation Activities

2.1 TRANSFORMER INVESTIGATION OBJECTIVES AND SCOPE

As mentioned in Section 1.1, the fieldwork was carried out in two phases. The focus of the Phase I work was to define the extent and possible origin of PCBs in soil and groundwater around the Area of Discovery, and to collect sediment and bank samples in the Duwamish Waterway to address the potential for migration and exposure pathways from the substation area to the waterway. The Phase I Report identified the following specific field activities to fill data gaps related to achieving project objectives:

- Collect additional soil samples from up to seven borings located east of the Area of Discovery to better define the vertical and horizontal extent of PCBs in this direction to a concentration of 1,000 µg/kg.
- Replace and resample substandard Wells PL2-006A and PL2-007A with larger diameter wells constructed to current standards.
- Install an additional A-Level monitoring well south of PL2-007A, but at a similar distance from the Area of Discovery to better assess the potential for downgradient transport of PCBs via the groundwater pathway.
- Investigate the storm system in the vicinity of the substation to determine the actual system layout, integrity, and connectivity and determine the concentrations of PCBs in catch basin and manhole solids.

Additionally, USEPA identified specific data gaps following a review of the Phase I Transformer Report and the Phase II Work Plan. The USEPA placed additional emphasis on the association between petroleum hydrocarbons and PCBs and on additional characterization of the soil and groundwater downgradient of the substation area. This was done in order to evaluate the potential for PCBs released near the substation that have migrated to the Southwest Bank area via the soil-to-groundwater pathway. Specifically, the USEPA directed:

- Collection of soil samples and one Geoprobe groundwater sample from four borings located to the west of the Area of Discovery, adjacent to and inside of the 2-66 sheetpile. The purpose of these samples was to better evaluate the potential for PCB migration via groundwater. If PCBs were detected in any sample at a concentration greater than 1,000 µg/kg, then a monitoring well would be installed in this location.
- Collection of subsurface soil samples from five borings to the south of the substation, within the Jorgensen Forge, to evaluate the potential for subsurface migration of PCBs in this direction. Additionally, if PCBs were detected in any sample at a concentration greater than 1,000 µg/kg, then a monitoring well would be installed in this location as well.
- Analysis of all soil samples for TPH.

- Determination of the mean hydraulic gradient in groundwater downgradient of the substation using a larger set of wells than was used during the Phase I investigation.

- Sampling of groundwater from a larger set of wells as compared to those sampled during the Phase I investigation.

All of the sampling and surveying objectives stated above are described in more detail in the Phase II Work Plan. The field implementation of the Phase II Work Plan was successfully completed with no deviations from the work plan. Figure 2.1 shows the locations of pre-existing and Phase II investigation explorations, monitoring wells, and storm pipes that were surveyed.

2.2 SUBSURFACE SOIL

Consistent with the Phase II Work Plan, 117 subsurface soil samples were collected from 19 locations (16 Geoprobe™ explorations and three hollow-stem auger borings). Samples were collected at 2-foot depth intervals to a depth of 16 feet bgs. The borings (advanced for installation of monitoring wells) were drilled to slightly greater depths (no deeper than 18 feet bgs) to meet monitoring well construction specifications. Water-saturated soil was first evident between 10 to 12 feet bgs. A geologist logged the soil using methods described in the RFI work plan (Weston 1994). Exploration logs are presented in Appendix A.

As specified in the Phase II Work Plan, analysis was performed in a phased approach for the samples collected from the seven borings located to the east of the Area of Discovery. All samples associated with the inner three borings were initially analyzed with samples from the remaining four "step-out" explorations placed on hold at the laboratory. Based on preliminary results from the initial set of analyses, subsequent analysis was performed on 11 samples from three of the four step-out borings, thereby fully defining the extent of PCBs to 1,000 µg/kg in this direction. Subsurface soil samples collected during this investigation that were not required to be analyzed per the Phase II Work Plan requirements remain archived in the custody of the laboratory. Also consistent with the work plan, samples collected from the four westward borings located near and inside of the sheetpile as well as the samples from the group of five boring located south of the substation were analyzed in one group (i.e., no phased analysis). All samples submitted for analysis were analyzed for PCBs and TPH.

2.3 MONITORING WELL INSTALLATION AND ABANDONMENT

Three new monitoring wells were installed as part of the Phase II Investigation: PL2-JF004A, a new well located on the Jorgensen Forge generally downgradient of the substation; Wells PL2-006AR and PL2-007AR were replacement wells for Wells PL2-006A and PL2-007A, which were narrow-diameter pre-RFI wells that were never properly developed and did not meet current construction standards for resource protection wells and so were abandoned per the Phase II Work Plan. Monitoring well locations are shown in Figure 2.1. Monitoring well construction logs are presented in Appendix A.

Two additional contingency wells were specified in the Phase II Work Plan; however, these wells were not installed because analytical results obtained from associated borings, as described in Section 2.1 above, were less than the installation trigger point (1,000 µg/kg).

2.4 GROUNDWATER MONITORING

Well sampling, measurements, and decontamination procedures followed the approved Quality Assurance Project Plan (QAPP) Addendum for Plant 2 (Weston 2001). Detailed descriptions of the field methods used are presented in Appendix A.

2.4.1 Chemical Monitoring

Groundwater samples were collected from seven monitoring wells and one Geoprobe exploration. The samples were submitted for laboratory analysis of PCBs (individual Aroclors), TPH, and total organic carbon (TOC). Field sampling data sheets for groundwater are presented in Appendix B.

2.4.2 Hydraulic Monitoring

Tidally induced fluctuations in groundwater levels at the Facility occur in response to hydraulic connection between groundwater and the Duwamish Waterway. The continuous fluctuation of the groundwater surface in response to tidal changes precludes the use of single-time groundwater measurements to evaluate net groundwater migration direction and gradient. Instead, mean groundwater elevations must be used to determine groundwater flow direction. For this investigation, water level measurements were collected from five monitoring wells (PL2-004A, PL2-007AR, PL2-030A, PL2-034A, and PL2-JF01A) using transducers and data loggers. A 72-hour mean groundwater elevation was then calculated for each well as described in Appendix A.

2.5 STORM SYSTEM SOLIDS SAMPLING AND SURVEY

The storm system solids sampling and survey activities were conducted February 15 through 17, March 8, and May 2 through 5, 2005. All survey tasks specified in the Phase II Work Plan were completed as described below. Survey and sampling methodologies are described in Appendix C, which also includes selected photos taken from the video survey.

2.5.1 Storm System Solids Sampling

Storm solid samples (i.e., silt, sand, and gravel accumulations in the base of manholes or catch basins) were collected from locations identified in the Phase II Work Plan (refer to Figure 2.1 for specific manhole and catch basin locations and identifying labels). A total of 13 storm solids samples were collected and submitted for analysis for PCBs and TPH. In addition, samples from SDMH 15A located along the 12-inch property line pipe were analyzed for polycyclic aromatic hydrocarbons (PAHs) and metals (for Boeing waste characterization purposes) as a thick layer of material had blocked the pipes at the base of the manhole and had to be removed and drummed to allow the video survey to proceed.

Amongst the 13 samples are several samples of opportunity collected from storm system features identified during the course of fieldwork. The first additional sample was collected from solids associated with a 6-inch concrete pipe found within SDMH 36-83. This pipe was traced back 12 feet from the manhole and found to originate on Jorgensen Forge. The solids sample

was collected from a grayish-black, low-density debris with a dry, crusty appearance and texture that was observed both within the 6-inch pipe as well as adhered to the interior wall of the manhole just below the pipe outlet. The second additional storm solids sample was collected from the bottom of SDMH 24A located along the 24-inch Property Line Pipe. SDMH 24A was not identified in the Work Plan because its existence was not known when the plan was prepared. Within SDMH 15A, three samples were collected due to the thickness and layering of material found at the base of the manhole. One sample was taken from the top 9 inches of a gravelly deposit found atop a 3-inch thick bottom layer of sand, which was also discretely sampled. A composite sample of both layers was also collected.

In addition to these 13 samples, samples were also collected from five manholes located upgradient (east) of the Transformer Investigation Area. These samples, while inherently beyond the Phase II Work Plan objectives, were collected as part of a broader source control evaluation (as explained in the Phase II Work Plan).

2.5.2 Storm System Survey

The purpose of the storm system survey was to determine the alignment and condition of existing pipes and to identify any unknown connecting pipes. Prior to the Phase II survey, the alignment, integrity, and connections of various components of the storm system could not be firmly established. Therefore, the potential existed for PCBs in soil or groundwater to enter the storm system through cracks and joints and become redistributed within the solids of the system, thereby making these pipes a possible active pathway for the migration of PCBs from the substation area to the waterway.

A brief description of the three major storm systems that drained or transited the Transformer Investigation Area is presented below. Survey findings and photographs of selected points of interest along the video survey are provided in Section 3.3 and Appendix C respectively.

The first major storm system lies within Plant 2 and served to drain the substation and its surrounding area. The substation itself was historically drained on its south side by a concrete conveyance trough running along the property line that also accepted drainage from pavement and roofs drains from buildings located near the substation. Discharge from the trough led into a stormwater vault near the southwestern corner of the substation and from there, to SDMH 36-83 (Figure 2.1). Prior to 1994, SDMH 36-83 discharged via a 12-inch pipe into the subsurface stormwater piping serving Outfall 9. In 1994, the 12-inch storm pipe leading to Outfall 9 was plugged at the manhole to allow for the construction of the sheetpile at Building 2-66. Stormwater was rerouted east via another 12-inch pipe within SDMH 36-83 that eventually discharged to the waterway via Outfall 9A.

Additionally, a number of other Boeing storm pipes were believed to be present in the substation drainage area, including a third 12-inch pipe thought to be located directly under the substation. These other pipes, (as represented on various Boeing drawings and maps) could contain residual contamination and, therefore, their existence and current functionality needed to be investigated.

The two other major storm systems of interest both lie outside of Plant 2, on the Jorgensen Forge property and consist of a 12-inch ID storm pipe[2] that formerly drained Plant 2 and a 24-inch storm pipe that drains King County International Airport (KCIA) and formerly drained a portion of Plant 2. These are referred to as the two parallel "Property Line Storm Pipes."

Video Survey Methods

The three storm systems included in the tractor mounted video camera survey are shown in Figure 2.1. Narrow diameter storm pipes were not surveyed by the tractor video due to diameter limitations, but instead were surveyed visually and their alignments traced on the surface by insertion of a steel snake equipped with a sonde radio transmitter and camera scope.

The Boeing pipes surveyed by either the video camera or sonde included:

- The 12-inch storm pipe under the substation leading into SDMH 36-83 from the east
- Two other smaller diameter pipes leading into this manhole
- The 12-inch outlet pipe that routes discharge to Outfall 9A

On the Jorgensen Forge, the 12-inch and 24-inch Property Line Storm Pipes, which drained to the Property Line Outfalls, were surveyed by video camera. Per the Phase II Work Plan, the video survey was continued in these pipes upgradient of the Transformer Investigation Area for broader source control purposes. To this end, the entire length of the 12-inch storm pipe on the Jorgensen Forge was surveyed to its point of origin on Plant 2, and the entire length of the 24-inch storm pipe was surveyed up to the last manhole before the pipe passes under East Marginal Way and continues onto KCIA[3].

Expansion Plugs

Following the survey, expansion plugs were inserted into two pipes within manholes considered inactive (but subject to tidal flooding) to fully contain residual PCB contamination found in the manhole solids. Specifically, a plug was installed in the 12-inch pipe on the outlet side of SDMH 36-83. Similarly, a plug was placed at the outlet side of SDMH 15A, the last manhole along the 12-inch Property Line Storm Pipe prior to its outfall.

[2] This 12-inch storm pipe was often referred to in previous reports as a 15-inch ID pipe. Measurements during the Phase II storm survey indicate that this pipe is actually 12-inch ID.

[3] The results of the broader storm structure survey were shown on a Weston figure provided by Boeing to the Agencies in July 2005.

3.0 Investigation Results

3.1 SUBSURFACE SOIL

In total, 96 subsurface soil samples from 15 explorations and three borings were analyzed during the Phase II Investigation for PCBs, using USEPA Method 8082, and TPH, using Washington State Method NW-TPH-Dx. Table 3.1 summarizes the analytical data reported for all Phase II soil samples. PCBs were detected in 15 of the 96 samples. The highest three total PCB concentrations (3,700, 5,000 and 3,900 µg/kg) were detected in the samples from 6 to 8, 8 to 10, and 10 to12 feet bgs respectively, from the boring advanced to replace monitoring Well PL-006AR.

Analytical results for samples analyzed for PCBs and TPH during prior or current investigations extending from the substation to the Southwest Bank are presented in Figures 3.1 and 3.2 respectively. Figure 3.1 presents the total PCB results in a series of frames, each representing samples collected at discrete 2-foot sample depths between 0 and 16 feet bgs. Figure 3.2 presents the TPH results for depths between 6 and 14 feet bgs, where the majority of data are available. For reference, the water table at the Facility typically is found between 10 and 12 feet bgs. Detected concentrations are in black and non-detect locations are in gray (the "U" designation indicates that the sample did not have any detectable PCBs at the reporting limit shown).

The sample results from 15 of the 96 Phase II soil samples analyzed had detectable PCB concentrations, five of which were greater than 1,000 µg/kg with three of these from a single boring (PL2-006AR) installed in an area of known PCB contamination (Phase II concentrations at this location were very consistent with historical data in this location). The remaining two were from SB-07250, the Phase II sample located closest to the Area of Discovery.

TPH was detected and quantified in the mineral spirit, diesel, and heavy oil ranges. These reference ranges were selected based on a review of Phase I chromatograms that indicated the TPH was present in each of these boiling-point ranges. TPH, when detected, was generally quantified in all three boiling-point ranges. The highest Phase II TPH concentration detected was 19,000 mg/kg (motor oil range) from a sample from Boring SB-07233r located on the Jorgensen Forge. Sample chromatograms for soils with TPH greater than 200 mg/kg are presented in Appendix D.

Isoconcentration contours of total PCB concentrations in soil generated by the methodology discussed in Appendix E, are presented in Figure 3.3. As in Figure 3.1, each frame represents a specific 2-foot bgs depth range, or "slice." The following generalizations were developed from a review of these contours and the data in Figure 3.1:

- PCB concentrations in soil are well "bounded" to a concentration of 1,000 µg/kg (a Transformer Investigation objective) in both the eastward and westward directions. The Area of Discovery release, as represented by the contours at this concentration, is approximately 70 feet wide, 140 feet long, and 14 feet deep.
- Concentrations of PCBs decrease considerably below 8 feet bgs.

- The center of the concentration contours within the saturated zone (between 10 and 16 feet bgs) is up to 60 feet downgradient of the Area of Discovery. This indicates limited downgradient migration has occurred along the water table, but the migration did not extend to the sheetpile enclosure.

3.2 GROUNDWATER

3.2.1 Analytical Results

Groundwater samples from seven monitoring wells and one Geoprobe were collected and analyzed for PCBs, TPH, and TOC. PCBs were not detected in any of the groundwater samples. Reporting limits ranged from 0.01 µg/L to 0.065 µg/L.

TPH was detected in three samples, with the highest concentrations reported in the sample from Well PL2-006AR (both mineral spirits and diesel ranges reported at 2.7 mg/L. Chromatograms were reviewed for both PL2-006AR and PL2-JF04A and both indicate a mixture of a diesel range product and a lighter hydrocarbon product (refer to Appendix D).

Table 3.2 summarizes all of the Phase II analytical data for groundwater and Figure 3.4 presents the PCB analytical results. Older RFI sampling for adjacent wells not sampled as Phase I or II are also included on Figure 3.4. This figure indicates that since the RFI, PCBs were only detected in one well within the Transformer Investigation Area, the now-abandoned Well PL2-006A. The Phase II sample from the replacement Well PL2-006AR did not contain PCBs to a concentration of 60 parts per trillion (ppt). This indicates that the prior samples in PL2-006AR were biased by (1) high turbidity due to its improper construction, and (2) the well being screened across a soil zone with elevated PCB concentrations.

Additionally, the Phase II Geoprobe groundwater sample result was non-detect for PCBs and PCBs were not detected in any of the four soil borings located near or within the sheetpile. This supports the conclusion that PCBs related to the release at the Area of Discovery are not occurring in a dissolved phase and have not migrated via the groundwater pathway (i.e., the groundwater pathway for exposure does not exist).

3.2.2 Hydraulic Monitoring Results

To better understand the hydraulic gradient in the Transformer Investigation Area and along the southern border of the Facility in general, results from three 72-hour mean hydraulic gradient determinations are discussed as follows:

- Phase I Transformer Investigation performed June 2003; results shown in Figure 3.5.
- Phase II Transformer Investigation performed in March 2005; results shown in Figure 3.5.
- Boeing South Yard Data Gaps Investigation performed February 2005; a figure from that report showing mean hydraulic gradients across the entire southern border of the Facility is reproduced as Figure 3.6.

These three studies all complement one another. Together they indicate that groundwater flows generally parallel to the southern border of the Facility including the Transformer Investigation Area. As groundwater reaches the sheetpile, the flow lines curve slightly to the south before discharging to the waterway. There is no southern component to groundwater flow at the substation pad area. The gradient in the Transformer Investigation Area is 0.007 feet/feet.

3.3 STORM SURVEY AND SOLIDS SAMPLING RESULTS

The results of the storm survey within the Transformer Investigation Area are shown in Figure 3.7. Three separate storm systems were surveyed as described in Section 2.5.2. Each system is shown in a different color on Figure 3.7. PCB concentrations (as Aroclors) in storm solid samples are also displayed in Figure 3.7 and summarized in Table 3.3 (which also presents analytical results for TPH). Further characterization of the storm solids for semi-volatile organics and heavy metals (performed for waste disposal purposes) is presented in Appendix F. Photographs of selected points of interest in the video survey are shown in Appendix C. Significant findings from the survey within the Transformer Investigation Area are as follows:

- Each storm system was found to be intact (upon review of the video) and have integrity (i.e., no broken, severely cracked, or missing sections of pipe were found) except for both Property Line Storm Pipes at a point just prior to their outfalls where a significant separation of the corrugated metal pipe was observed that prevented further survey.
- No cross connection between these three systems and/or the substation area was found.
- For the system serving SDMH 36-83, the following observations were made
  - A 6-inch ID pipe leading into SDMH 36-83 from the Jorgensen Forge was discovered. All other pipes within this manhole originated at the Facility and run in the direction expected (from recent Boeing Facility drawings).
  - PCB concentrations are elevated (590,000 µg/kg PCBs) in both this pipe and the solids at the base of the manhole (151,000 µg/kg PCBs).
  - As compared to the elevated PCB concentrations within SDMH 36-83, concentrations are significantly lower (less than 5,000 µg/kg PCBs) in the stormwater trough and vault draining to this manhole, as well as the Boeing catch basins surrounding the substation, and in SDMH 36-705 (which has received discharges from SDMH 36-83 since 1994).
  - All of the storm pipes leading into SDMH 36-83 are inactive (i.e., do not currently drain stormwater). Except for the limited amount of surface water entering into this manhole from the stormwater trough and vault, this manhole has been inactive since 1994 when it was rerouted to discharge to Outfall 9A.
- For the 24-inch Property Line Storm Pipe originating at KCIA, the following observations were made for that section transiting the Transformer Investigation Area (refer to Figure 3.7):

  - * One manhole along the 24-inch pipe was discovered (designated SDMH 24A) having been obscured by gravel.
  - * A 12-inch diameter pipe coming in from the Jorgensen Forge was discovered approximately 12 feet upgradient of SDMH 24A. Very elevated concentrations of PCBs were detected in the solids sample from this manhole (10,000,000 µg/kg); however, since this piping has integrity and is not connected to the drainage system for the substation, the source for these PCBs is not unrelated to the release at the Area of Discovery

- For the 12-inch Property Line Storm Pipe, the following observations were made for that section transiting the Transformer Investigation Area:
  - * PCB concentrations in the solids within SDMH 15A located approximately 50 feet east of the Area of Discovery contain elevated levels of PCBs (350,000 µg/kg) but since this piping does not have any connections to the drainage system for the substation, the source for these PCBs are deemed unrelated to the release at the Area of Discovery.

For those sections of both Property Line Storm Pipes that lie upgradient of the Transformer Investigation Area, the following observations were noted (and reported here for broader source control purposes):

- A second manhole, designated 24B, was discovered along the 24-inch Property Line Storm Pipe, approximately midway between East Marginal Way and the Duwamish Waterway.
- The 15-inch concrete pipe originating on Plant 2 that is shown connecting to the 24-inch pipe via SDMH 37-7 as portrayed in construction drawings was verified to exist and verified to be inactive.
- Two heretofore unknown pipes (12-inch and 6-inch) were noted leading into the "Public" SDMH near East Marginal Way and appear to be inactive.
- The 12-inch Property Line Storm Pipe system was verified to originate entirely within Plant 2, and verified to be inactive.
- The concentration of PCBs in the storm solids at the base of all manholes along these two piping systems are elevated (all sample results are greater than 100,000 µg/kg).

3.4 GROUNDWATER ELEVATIONS VS. STORM PIPE INVERT ELEVATIONS

Groundwater level monitoring was conducted in five monitoring wells during March 14 to 18, 2005 as described in Section 2.4 and in further detail in Appendix A. As shown in Table A.2 in Appendix A, the peak groundwater elevations measured in the wells (corresponding to high tide in the Duwamish Waterway) ranged from approximately 2.9 to 3.9 feet (NGVD 29). Based on an extrapolation of the elevation data, the estimated peak groundwater elevation beneath the substation was 3 feet NGVD at the time the monitoring was conducted. This elevation value compares well with peak groundwater elevation data measured during the RFI (Weston 1997).

The elevation of the bottom of SDMH 36-83, the manhole closest to the waterway, is 4.6 feet NGVD or 10.6 feet Mean Lower Low water (MLLW) (Figure 3.8). Therefore, the peak groundwater elevation of 3 feet NGVD occurring during the monitoring period was 1.6 feet below the bottom of this manhole and its associated pipes in the vicinity of the substation. Surveyed elevations are not available for SDMH 15A and SDMH 24A; however, they can be approximated (based on hand measurements) as 5 feet NGVD for SDMH 15A and 3.5 feet NGVD for SDMH 24A (Figure 3.8). Based on these elevations, it appears that the manholes and pipes in the vicinity of the substation are located above peak groundwater elevations occurring during average high tides. Rare extreme high tides could conceivably result in groundwater elevations that, for a limited period of time, rise above the elevations of the manhole and pipe inverts, particularly for the 24-inch storm pipe. More significantly, Boeing Outfall 9A and the Property Line Outfalls are submerged during high tides, allowing tidal waters to enter the pipes and then drain back out during lower tides.

To illustrate the above discussion, storm pipe profiles (referenced to both NGVD and MLLW) for each of the three storm systems surveyed in the Transformer Investigation Area are presented in Figure 3.8. This figure shows the elevation of the storm pipe inverts and manholes based on Boeing construction drawings and the storm survey. Superimposed on the profiles are the high and low range of groundwater elevations encountered during the monitoring period. The profiles also show PCB concentration contours along the three profiles based on the contours presented in Figure 3.3. As indicated in Figure 3.8, both the Boeing 12-inch pipe that runs under the substation and the 12-inch Property Line Storm Pipe on Jorgensen pass through a zone of elevated PCB concentrations below the Area of Discovery. In contrast, the 24-inch Property Line Storm Pipe appears to pass below the contoured extent of the PCB release.

3.5 DATA QUALITY AND ELECTRONIC DATA DELIVERABLE

Data quality review was conducted on each sample batch analyzed for this investigation per the Phase II Work Plan requirements. Data qualifiers were assigned to specific samples as warranted. A review of the data quality is presented in the Data Validation Report contained in Appendix G[4]. In summary, the laboratory analysis met the data quality objectives specified in the approved Phase II Work Plan. No deficiency was identified.

The associated CD to this report contains an Excel-based electronic data deliverable containing data tables of all Phase I and II analytical data.

[4] The data validation report includes all samples collected during the storm system survey, including samples collected from manholes along the 12-inch and 24-inch ID storm lines upgradient of the general substation area. Refer to Section 2.5.1 and Appendix G.

4.0 Discussion

4.1 NATURE OF RELEASE AT THE WEST BANK SUBSTATON

It has not been established when or how the PCBs found in the Area of Discovery were released to soil. No historical use or storage of PCBs is known by Boeing to have occurred in that part of the Transformer Investigation Area within Plant 2, and the area has been paved since its initial development in 1942, well before installation of the substation.

Potential release mechanisms associated with the utility substation include leaks of PCB-containing dielectric fluid directly from the former transformers or releases occurring during maintenance of the transformers. Samples collected during decommissioning of the transformers in 2004, however, contained no reportable concentration of PCBs in the transformer dielectric fluid, and PCBs were also absent in the residual fluid present in the base or "heel" of the transformers following draining. Prior testing of the dielectric fluid from these transformers by SCL in 1985 reported no detectable trace of PCBs as well. Relatively low levels of PCBs were detected in wipe samples taken from stained surfaces from the exterior shells of the transformer units, while the debris swept from under the transformers after removal showed a total PCB concentration of 4,000 µg/kg. One of five concrete chip samples from the pad showed a total PCB concentration of 3,000 µg/kg.

A review of records provided by SCL indicate that there were two sets of transformers present at the substation during its operational lifetime. The initial set of transformers, built by General Electric (GE), were removed by SCL in 1957 and replaced with a set manufactured by Westinghouse that remained on-site until 2004. The GE transformers were decommissioned by SCL in the 1980s and PCBs were detected at 6 parts per million (ppm) in a combined sample of the dielectric fluid. PCB testing data are not available for the late 1950s when the transformers were installed; however, SCL maintenance records from the late 1960s and early 1970s indicate oil seepage and leaks from the transformers. Boeing personnel have observed leaks in the Westinghouse transformers in the years prior to decommissioning.

Another possible source that cannot be ruled out involves sources originating on Jorgensen Forge as evidenced by the presence of PCBs in the 6-inch pipe in SDMH 36-83 originating at Jorgensen Forge. The concentration of PCBs in this pipe, which lies approximately 70 feet from the Area of Discovery, were comparable to the concentration of PCBs found in soil within the Area of Discovery.

4.2 EXTENT OF PCBS IN SOIL

The PCB concentration contours at successively deeper depths, as shown on Figure 3.3, best illustrate the extent and distribution of PCBs surrounding the Area of Discovery. This figure, produced using all available data, indicates that the highest concentrations are found across the unsaturated soil in and beneath the Area of Discovery, which strongly suggests a surface release. A smaller and less significant release is suggested near the stormwater vault based on the second "hot spot" shown in the 0-to 2-foot bgs depth contour; however, this hot spot is not persistent with depth. Lower, but still elevated levels of PCBs persist in soil between the 2-to

8-foot bgs depth interval and their broader extent eastward and westward in unsaturated soil away from the Area of Discovery implies that some lateral migration of PCBs occurred (to a distance of approximately 50 feet in either direction). The elongated shape is assumed to be a function of how the release entered the ground and traveled along preferential pathways in soil layers, as indicated by the variability in closely spaced samples taken from the Area of Discovery.

Figure 3.3 also shows that the lateral extent and concentration of PCBs decreases significantly beginning at 8 to 10 feet bgs, but is persistent in a downgradient direction to a depth of 14 feet bgs. The 10- to 14-foot bgs depth interval corresponds to the seasonal range of the shallow groundwater surface in this section of the Facility (Weston 1996). Between 14 to 16 feet bgs, the release diminishes greatly in size and concentration with all detections less than 1,000 µg/kg.

The extent to which the PCBs may have migrated along the groundwater surface towards the waterway was a focus of the Phase II Investigation, as the extent of the PCBs found between 8 to 14 feet bgs during Phase I indicated a shift westward away from the Area of Discovery. The Phase II data collected from the four borings adjacent to and inside the sheetpile, however, indicate an absence of PCBs in soil and groundwater in this area. This implies that downgradient migration of PCBs along the water table did not reach the sheetpile. This was not an unexpected finding given the very high partitioning coefficients of PCBs to soil.

4.3 ASSOCIATION OF PCBS WITH TPH IN SOIL

4.3.1 Spatial Association

Field observations recorded in the Phase I and II boring logs indicate that petroleum odor/sheen was detected in approximately half of the borings, either in association with the water table and/or in unsaturated soils. Petroleum odor was also noted in the boring within the Area of Discovery (SB-7221) and in nearby borings close to the substation (SB-7217, SB-7213) and in the boring for replacement monitoring Well PL2-006AR. Sheen was noted on the surface of the samples collected from approximately half of the borings located on Jorgensen Forge, away from the Area of Discovery.

Figure 3.2, when compared to Figure 3.1, illustrates that the TPH in the subsurface soil is more widespread than the extent of PCBs. For example, samples with TPH detections located to the south, on Jorgensen Forge, do not have corresponding PCB detections. Similarly, PCBs have never been detected north of the sheetpile where diesel light non-aqueous phase liquid (LNAPL) was removed by Boeing in an action during the mid to late 1990s. This wide-spread, uneven pattern of TPH distribution indicates multiple releases at various locations rather than a release(s) originating at a single location. In contrast, the PCB pattern is consistent with a release only at the Area of Discovery. The data indicate that while TPH could have been released along with PCBs at the Area of Discovery, the TPH would then simply add to the wider presence of TPH from other releases occurring on both sides of the property line.

Figure 3.2 also illustrates that TPH concentrations decrease with depth, as expected. Below 14 feet bgs, the extent of both PCBs and TPH diminishes greatly. This suggests that the PCB

release did not occur as a separate phase dense non-aqueous phase liquid (DNAPL) capable of downward migration through the saturated zone.

4.3.2 Statistical Correlation

The general association between PCBs and TPH concentrations was examined in further detail by statistically correlating the Phase I and Phase II data. Of the 109 samples analyzed for both TPH and PCBs, only 30 were reported to contain both PCBs and TPH. For those 30 samples, the concentration of total PCBs was plotted against the concentration of total TPH (Figure 4.1). Little correlation is apparent in this figure. The coefficient of determination (r^2; 0.096) for this data set is not significant at α=0.05, implying that TPH is not a predictor of PCB occurrence or concentrations.

4.4 EXTENT OF RELEASE IN GROUNDWATER

PCBs were not detected in any of the groundwater samples analyzed during Phase II activities to a reporting limit of 30 to 60 parts per trillion (ppt). This is consistent with Phase I results, with the exception being Well PL2-006A, which historically has reported PCBs concentrations. This well was abandoned due to its substandard construction and replaced with Well PL2-006AR during Phase II activities. Well PL2-006A was an older 1.25-inch diameter well installed in 1988 and, because of its construction, it was not possible to properly develop the well to remove suspended solids. Because this well was screened across soils with high TPH and PCB concentrations, it was critical to have a well designed and constructed under current standards to ensure that groundwater, and not suspended solids from contaminated soils, were being measured. The prior detections of PCBs in the groundwater from PL2-006A are believed to have been a result of PCBs attached to suspended solids and not dissolved phase PCBs. In summary, Phase II data indicate that groundwater transport of PCBs is not an active transport pathway.

4.4.1 Potential Transport by Non-aqueous Phase Carrier

At the request of USEPA, the following two potential transport mechanisms are discussed below:

- Transport of PCBs as LNAPL
- Transport of PCBs in groundwater as a commingled PCB/TPH plume

The Phase I and Phase II data together find no statistical association between PCBs and TPH near the substation. Although they are commingled near the water table, the PCBs and TPH appear to have separate, and for TPH, multiple sources.

For LNAPL transport to occur there must first be an LNAPL phase present. If present, PCBs would be expected to dissolve into the LNAPL (both being non-polar) and move where the LNAPL moves; however, transport by LNAPL is not considered to be significant, as there is no evidence for LNAPL in the Transformer Investigation Area. For example, LNAPL was never observed in former Well PL2-006A, located directly where the highest concentration of TPH was detected. Also, PCB and TPH concentrations under the Area of Discovery diminish at the water

table where much higher concentrations would be expected if LNAPL were present. Accordingly, without free-phase LNAPL there can be no risk of continued migration by this mechanism.

PCBs migration in groundwater can theoretically be enhanced by the presence of other chemical species through a process called co-solvation. In this process, TPH and solvents can increase the solubility of PCBs in water, which would tend to increase their mobility. However, PCBs were not detected in groundwater at parts per trillion levels during Phase II activities, even in those samples with the highest TPH concentrations. Therefore, the Transformer Investigation Area data indicate that this co-solvation mechanism is not occurring there.

4.5 SOURCES AND EXTENT OF RELEASE IN STORM SYSTEM SOLIDS

The video survey indicates that the 12-inch and 24-inch Property Line Storm Pipes have integrity (i.e., no cracks or open joints) while transiting past the substation and no cross-connection exists between these pipes and the pipes in the storm system draining the substation area. Therefore, the PCBs detected in the solids samples taken from these pipes have other sources unrelated to the PCBs released at the Area of Discovery. Sources for PCBs found in the Property Line Storm Pipes, as summarized in Table 3.3, are not discussed further in this report.

PCBs were also detected in storm system solids within the drainage area of the substation and so may be related to the release at the Area of Discovery. With the exception of SDMH 36-83, however, the concentrations were low (less than 5,000 µg/kg) and consistent with levels in storm solids at urban locations including those in King County (King County et al. 2005; City of San Jose 2002).

Elevated PCBs were detected in SDMH 36-83 in both the storm solids at the bottom of the manhole and the 6-inch pipe leading into the manhole:

- A total PCB concentration of 151,000 µg/kg detected in the solids at the bottom of the manhole was distributed amongst three Aroclors, including Aroclor 1242, which was not otherwise detected in Transformer Investigation Area soil.
- Additionally, the material within the 6-inch pipe leading to this SDMH from the Jorgensen Forge contained PCBs at a higher concentration of 590,000 µg/kg (Aroclors 1254 and 1260).

Given that SDMH 36-83 served the Transformer Investigation Area and because sediments in front of the historical outfall 9A also contain these Aroclors, it is likely that PCBs associated with the release at the Area of Discovery and/or the Jorgensen 6-inch pipe made it to the waterway via this storm system.

4.6 CORRELATION OF PCBS IN SEDIMENT AND ADJACENT UPLANDS

Figure 4.2 is a summary figure showing contoured PCB concentrations for both the uplands (Southwest Bank and Transformer Investigation Area) and the southern boundary of the DSOA, and the frontage along Jorgensen Forge. This figure incorporates results for PCBs using all

available soil and sediment data. Area 1 data and more recent results from samples collected in front of the Jorgensen Forge facility (termed Area E) during the summer of 2004 were also included. The figure was generated using the maximum PCB concentration found at any depth in both media[5], and it provides a framework for the following observations drawn from all available data.

4.6.1 Uplands Release at the Area of Discovery through Outfalls 9/9A

The contours next to the substation show an area of contamination approximately 140 feet long by 70 feet wide centered around the Area of Discovery, but not extending past the sheetpile. The release has not reached the waterway via a subsurface transport mechanism; however, the release is believed to have reached the waterway via Outfall 9/9A. This storm system could also have transported PCBs from other sources as discussed above.

4.6.2 Contamination in the Southwest Bank

PCB contamination also exists in the debris fill that comprises the Southwest Bank. This contamination is unrelated to the Area of Discovery release but may have contributed to sediment contamination at the foot of the bank.

4.6.3 Sediments and the Property Line Outfalls

PCB contamination in sediment also appears to be directly associated with the Property Line Outfalls based on the sediment hotspot in front of these outfalls and the elevated concentrations of PCBs within the storm solids along these associated manholes. Due to the proximity of the Property Line Outfalls, Outfalls 9/9A, and sediment transport processes, it is likely that respective releases from the two outfall areas have commingled.

4.6.4 Summary

In summary, the sediments located along the southern portion of the Southwest Bank, the DSOA, and along the northern portion of Jorgensen Forge (to approximately Jorgensen Outfall 9) were studied as part of the Transformer Investigation. PCB migration from the Area of Discovery did not reach the waterway via subsurface transport mechanisms; however, they are believed to have historically reached the waterway via the storm system that discharged through Boeing Outfalls 9/9A. Although Outfall 9A is still an active pipe, contamination from the Area of Discovery and from the 6-inch pipe leading into SDMH 36-83 from Jorgensen Forge can no longer reach the waterway; as this manhole has been plugged (as a temporary measure).

PCBs released from Outfalls 9/9A contributed to the contamination in the southern portion of the present DSOA. PCBs released from the Property Line Outfalls contributed to the area of PCB contamination in front of the Property Line Outfalls. This investigation was unable to distinguish between the two sources of contamination based on Aroclor pattern.

[5] The geospatial analysis technique used to generate the sediment contours shown in this figure was developed by the Geospatial Work Group, comprised of representatives from the USACE, Ecology, and Boeing as part of the Southern Boundary Decision. A summary description of this technique is provided in Appendix E.

4.7 CONCEPTUAL SITE MODEL UPDATE

The CSM, as it was understood prior to Phase II activities, was presented in Section 1.3. Prior to Phase II, concerns focused on the potential for former or active pathways to transport PCBs in soil via groundwater to surface waters or via stormwater to surface waters through Outfall 9/9A and/or the Property Line Outfalls. Specifically, the CSM was unclear on:

- Potential transport of PCBs in groundwater to the waterway, either in a dissolved phase or non-aqueous carrier, perhaps resulting in transport to soils in the Southwest Bank.
- Potential for residual PCBs to be present in catch basin, piping, or manhole solids.
- Potential seepage of PCB-contaminated soil into the subsurface pipes through cracks or joints.

The Phase II data supports the following CSM revisions:

- The PCBs associated with the Area of Discovery release have not migrated to the sheetpile enclosure and are not associated with the PCBs in the Southwest Bank debris fill.
- Transport of PCBs via groundwater to the waterway is not a viable exposure pathway, either in a dissolved state or non-aqueous carrier.
- An exposure pathway was historically complete from the Area of Discovery to SDMH 36-83 to the waterway, but other contributions to the PCBs in this manhole were identified, including that from the 6-inch pipe leading to the manhole from Jorgensen Forge. Contamination remaining in this manhole can no longer reach the waterway as the outlet for this manhole was plugged.
- PCBs associated with the Area of Discovery release did not migrate into the Property Line Storm Pipes; however, PCBs from sources other than the Area of Discovery are present in these pipes.

5.0 Conclusions

These requirements are judged to have been fulfilled as supported by the results of the Phase I and Phase II Transformer PCB Investigations:

1. The hydrogeologic regime underlying the Transformer Investigation Area has been characterized in sufficient detail to evaluate the nature and extent of the Area of Discovery release:
   * The extent of PCBs in soil to 1,000 µg/kg measures approximately 70 feet by 140 feet by 14 feet in depth.
   * Groundwater gradients and flow directions have been characterized, and groundwater wells have been installed and sampled downgradient of the Area of Discovery.
   * PCBs were not detected in groundwater to sub-part-per-billion levels during the Phase II Investigation. A dissolved phase PCB plume in groundwater is not occurring.
2. Sufficient data have been gathered to make decisions on the need for stabilization to prevent the spread of contamination and protect human health and the environment:
   * No soil stabilization is necessary at this time. The site is paved and access is controlled; therefore, there is no current exposure to contaminated soil.
   * The potential for an ongoing release to the waterway via the storm system on the Plant 2 property has been temporarily eliminated, awaiting a final remedy, by plugging the outlet of the affected manhole.
3. PCB contamination from the release that may have migrated from the Area of Discovery and its migration pathway have also been characterized:
   * PCBs were not found associated with a NAPL phase.
   * PCBs were not found to have migrated with groundwater as either a NAPL or a dissolved groundwater plume.
   * PCBs are believed to have entered the stormwater system historically and discharged through Outfalls 9/9A.
   * PCB contamination in the sediments in front of Outfalls 9/9A were adequately characterized and define a sediment hotspot in this area.
   * There is no indication that the PCB release at the Area of Discovery entered the Property Line Storm Pipes through either direct connections or subsurface cracks.
   * The occurrence and nature of PCBs found within the Property Line Storm Pipes and in sediments in front of the Property Line Outfalls indicate that other sources of PCBs were released to these storm systems and reached the waterway.
4. The potential human and ecological receptors to hazardous constituents at or from the Facility associated with this release remain those associated with sediment contamination in the area: tribal fishermen, benthic invertebrates, and resident fish and shellfish populations.

5. The Phase I and II data are sufficient to support the development and analysis of corrective measure alternatives for this release.

6.0 References

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Phase II Transformer PCB Investigation Report

Figures

August 3, 2005

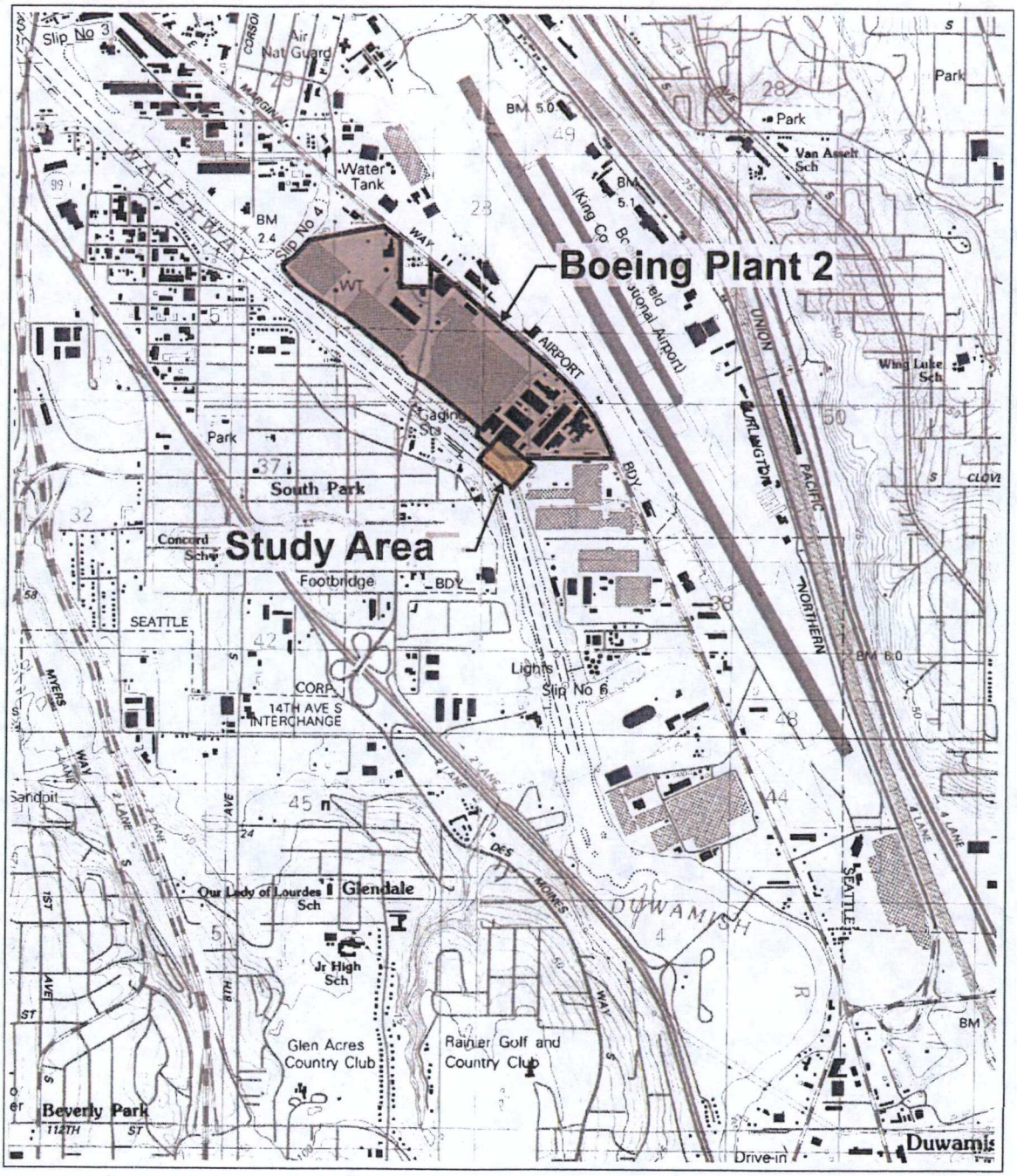

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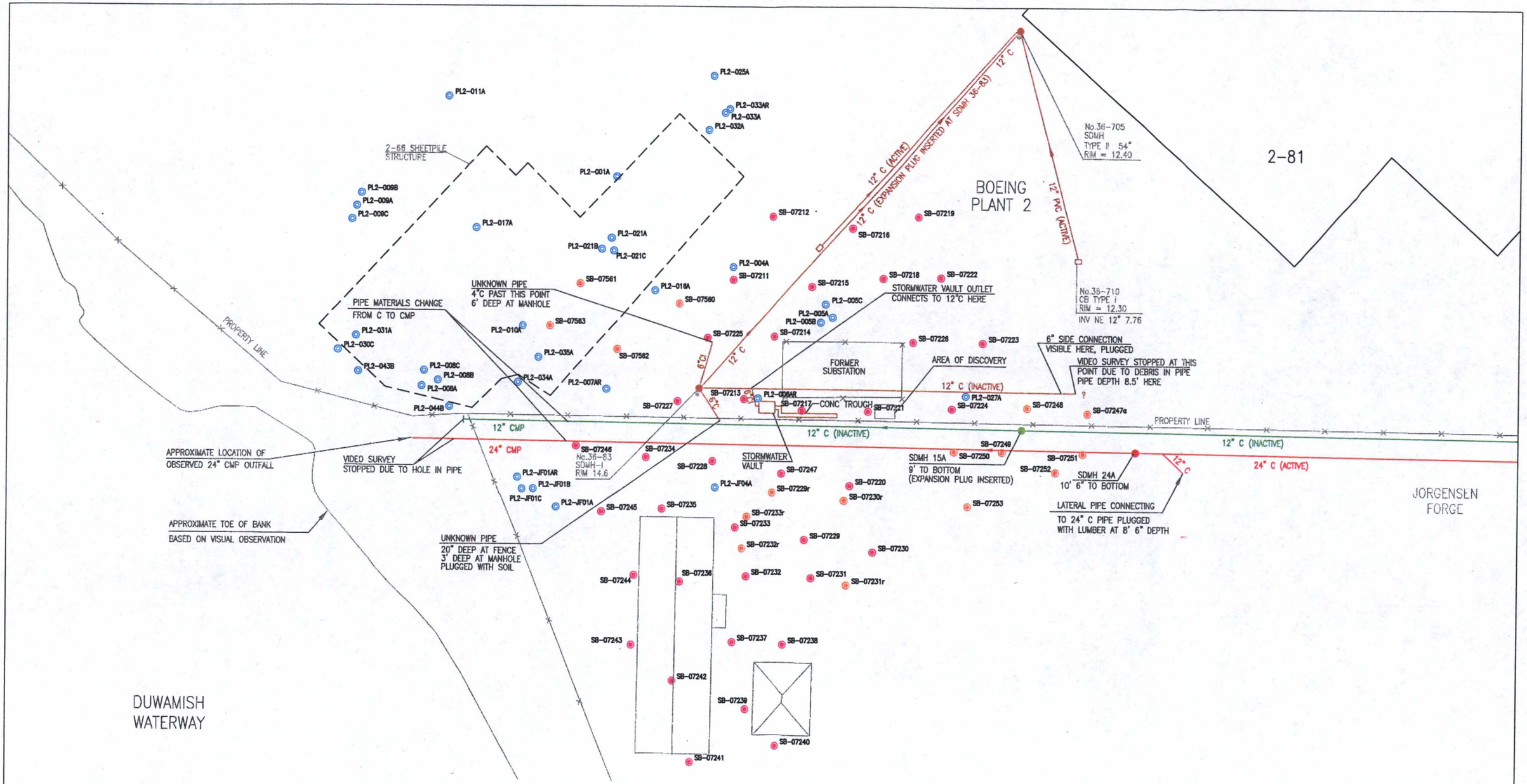
Figure 1.1
Vicinity Map

August 3, 2005



NOTES:
1) STORM PIPES SHOWN IN COLOR WERE INVESTIGATED USING A VIDEO CAMERA OR SNAKE/SONDE EQUIPMENT. INVESTIGATION CONDUCTED BY WESTON IN FEB AND MAY 2005.

SCALE (FEET): 0 20 40 80

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

PHASE II TRANSFORMER PCB INVESTIGATION
BOEING PLANT 2
SEATTLE, WASHINGTON

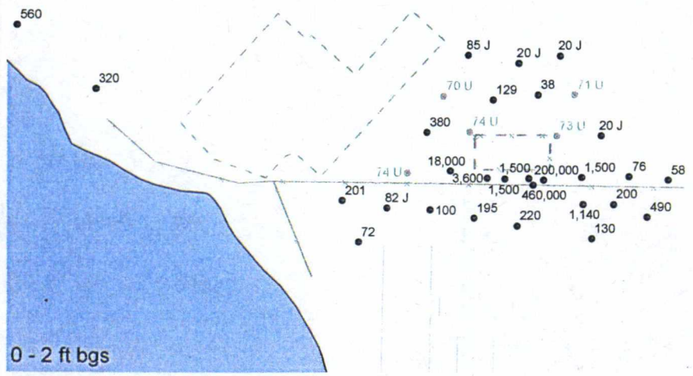
WESTON SOLUTIONS — SEATTLE WASHINGTON

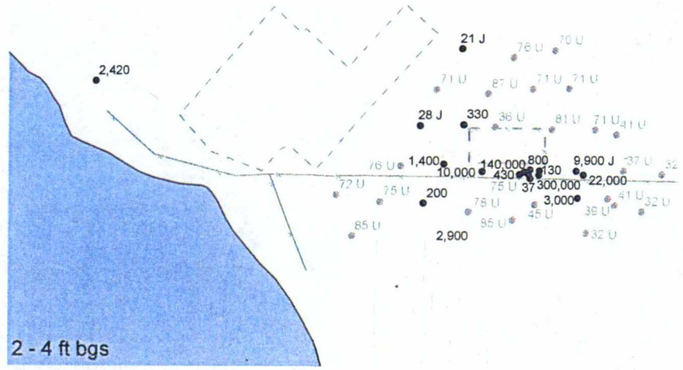
	CHECKED	DATE
DES. ENG.		
PROJ. ENG.		
PROJ. MGR.		
APPROVED		
APPROVED		

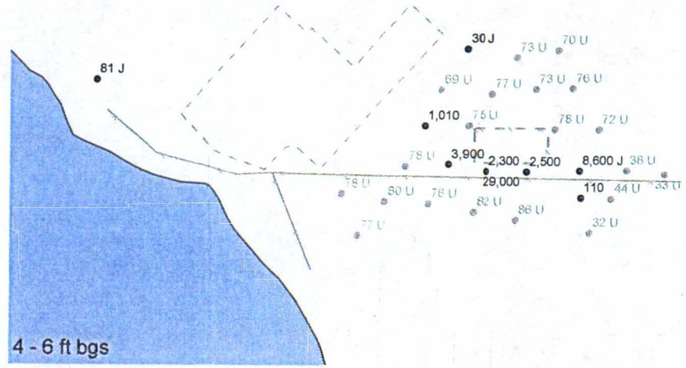
EXPLANATION OF DRAWING SYMBOLS
- CHAIN LINK FENCE
- MANHOLE (COLOR VARIES)
- C CONCRETE
- CMP CORRUGATED METAL PIPE
- PVC POLY VINYL CHLORIDE
- CI CAST IRON
- STORMWATER FLOW DIRECTION
- PHASE I SOIL EXPLORATIONS
- PHASE II SOIL EXPLORATIONS
- EXISTING MONITORING WELLS

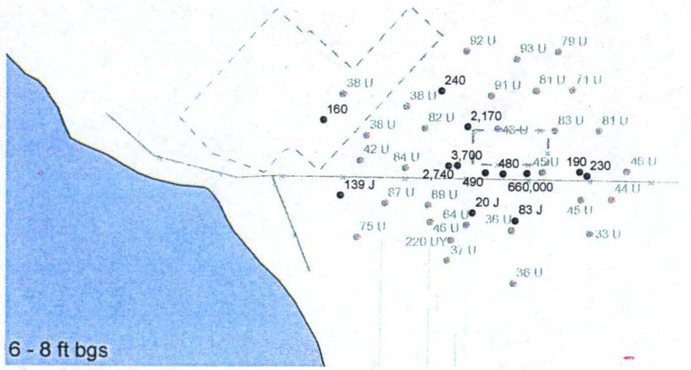
FIGURE 2.1
EXPLORATION LOCATIONS AND STORM PIPES SURVEYED

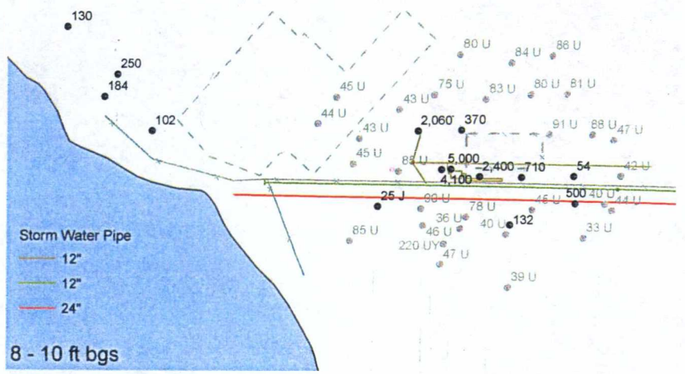
DRAWN	DATE	DWG. NO.	REV. NO.
DLD	JULY 29, 2005	BP2-TPB	0
SCALE 1" = 40'	W.O. NO. 03709-079-001-0004 RPT NO. 05-0098	SHT. 1 OF 1	

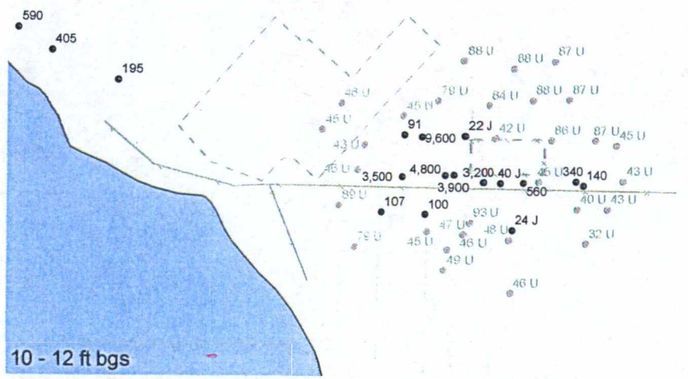


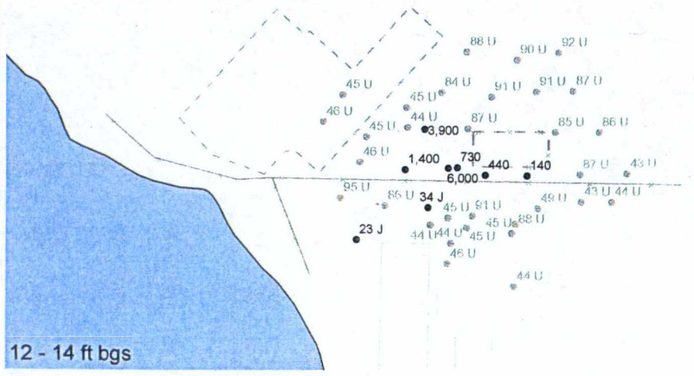


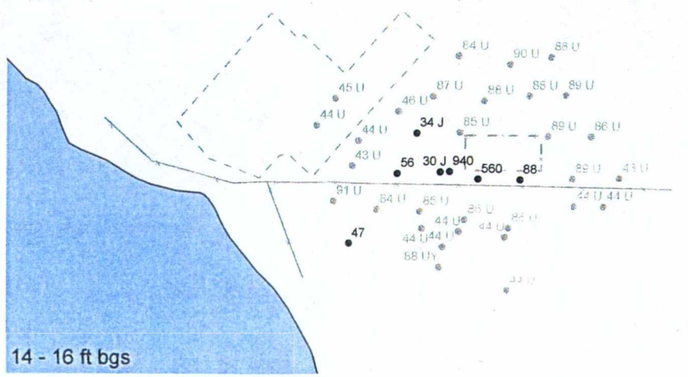












Legend

- PCBs Detected at Conc. Shown (µg/kg dry wt.) — e.g. 21
- PCBs Not Detected at Conc. Shown (µg/kg dry wt.) — e.g. U
- Sheet Pile
- Property Line
- Waterway
- Building
- Transformer Pad

N

0 100 200

Feet

NOTES:

1) Includes RFI, SW Bank, Area of Discovery, Phase I and Phase II data
2) PCB concentrations are totals of all Aroclors

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Figure 3.1
Total PCB Analytical Results for Soil - Variation with Depth

DATE: 8/2/2005 8:47:55 AM
MXD NAME: \\Sam\Data\projects\Boeing - Plant 2\GIS\Phase II Trans Rpt\Figure 3.1 - Total PCB Results.mxd

August 3, 2005

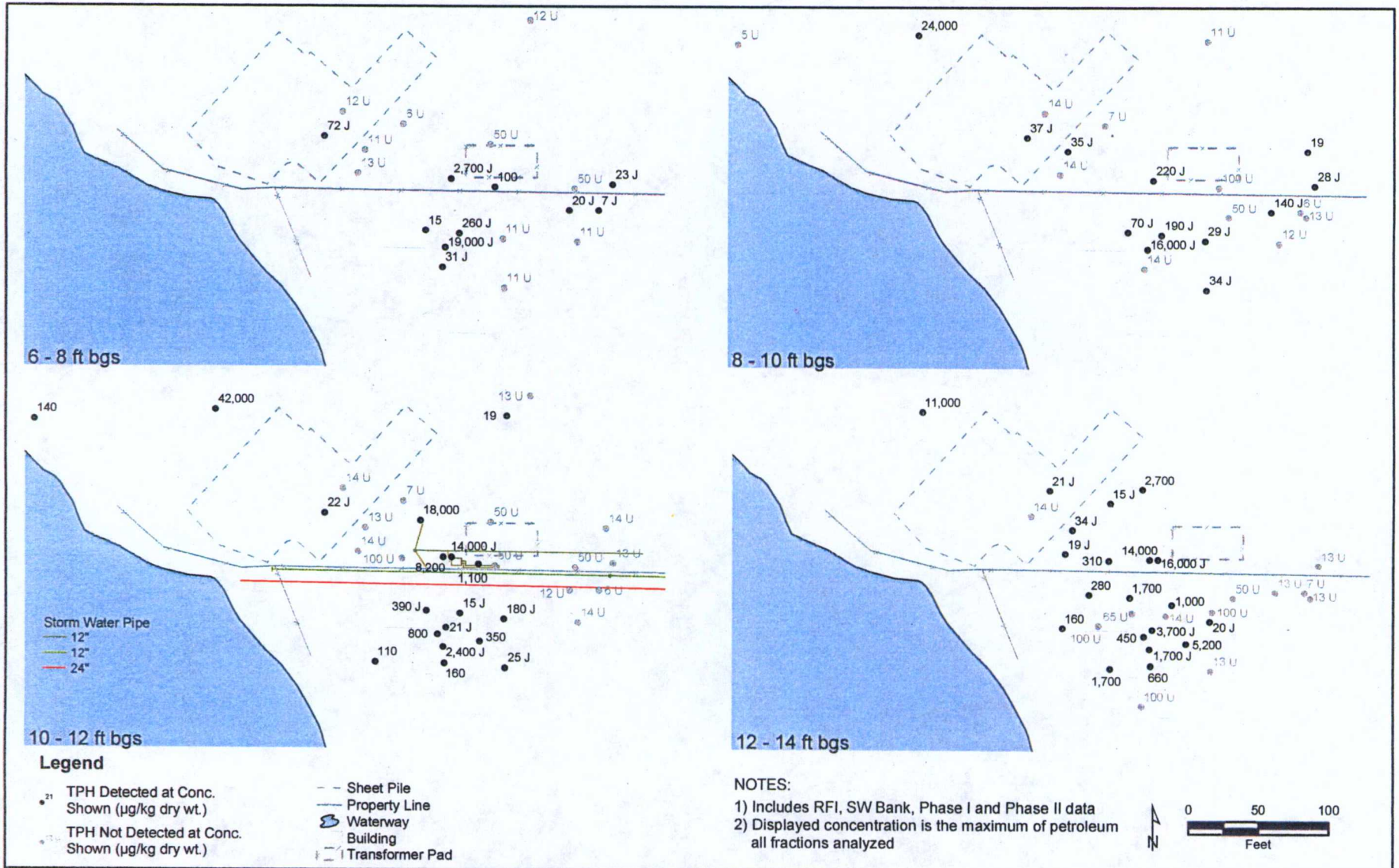

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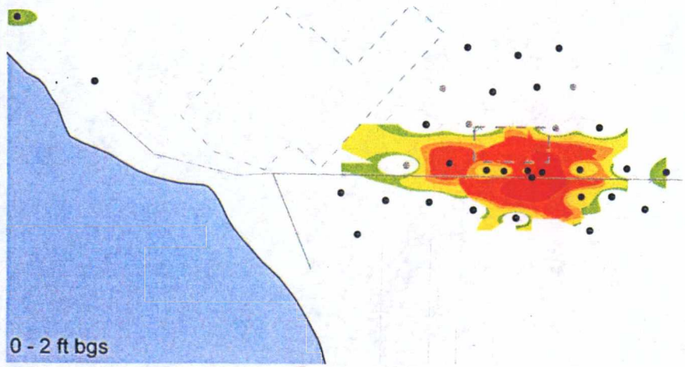
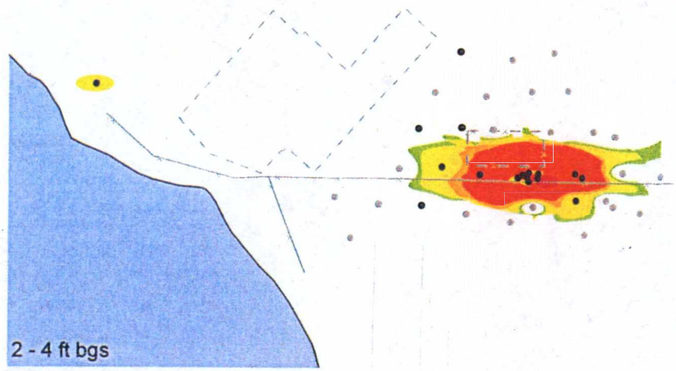
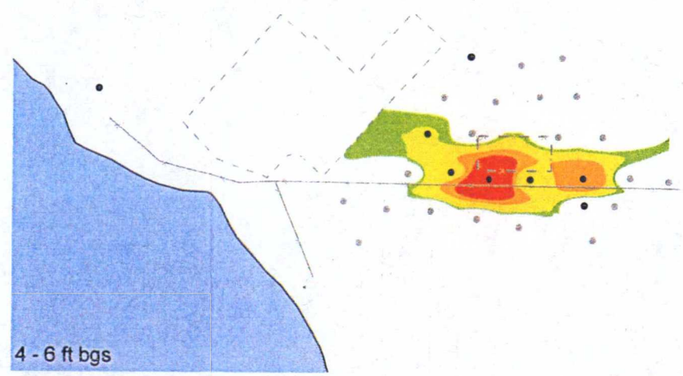
Figure 3.2
TPH Analytical Results for Soil
- Variation with Depth

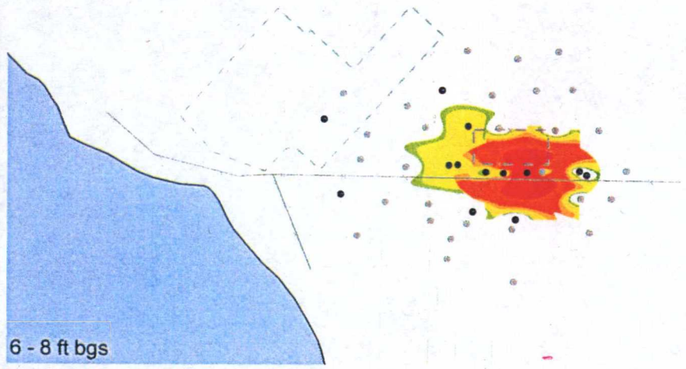
DATE: 8/1/2005 3:54:09 PM
MXD NAME: \\Sam\Data\projects\Boeing - Plant 2\GIS\Phase II Trans Rpt\Figure 3.2 - Max TPH Results.mxd

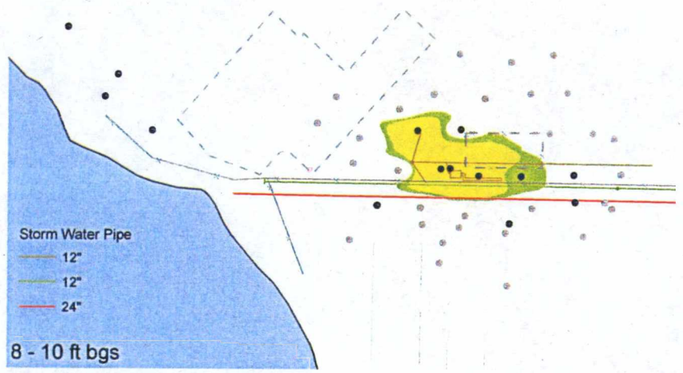
August 3, 2005

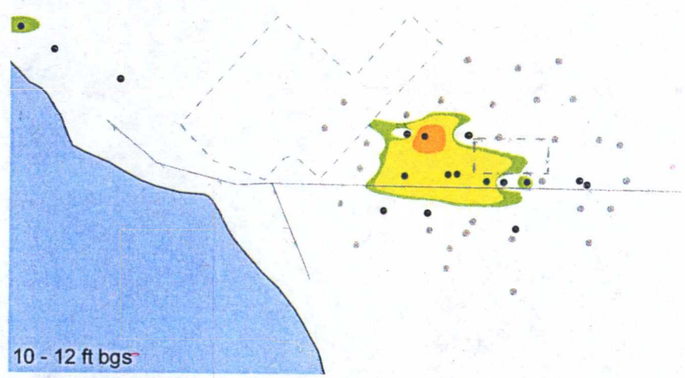


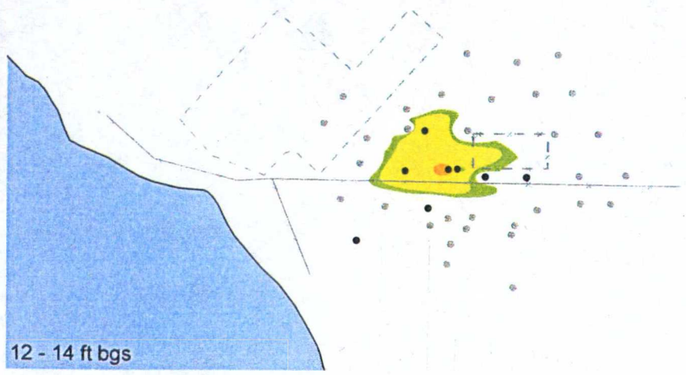


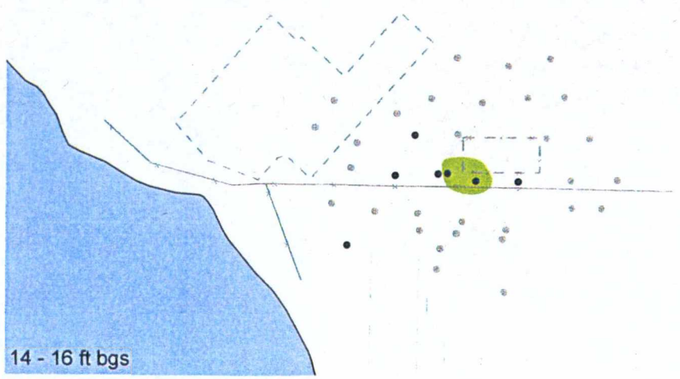


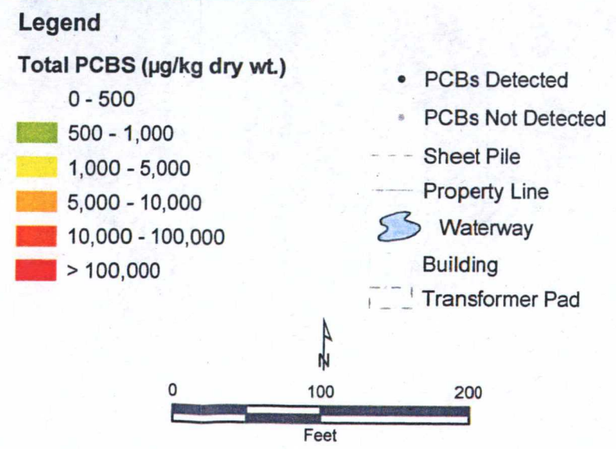












NOTE: Includes RFI, SW Bank, Area of Discovery, Phase I and Phase II data

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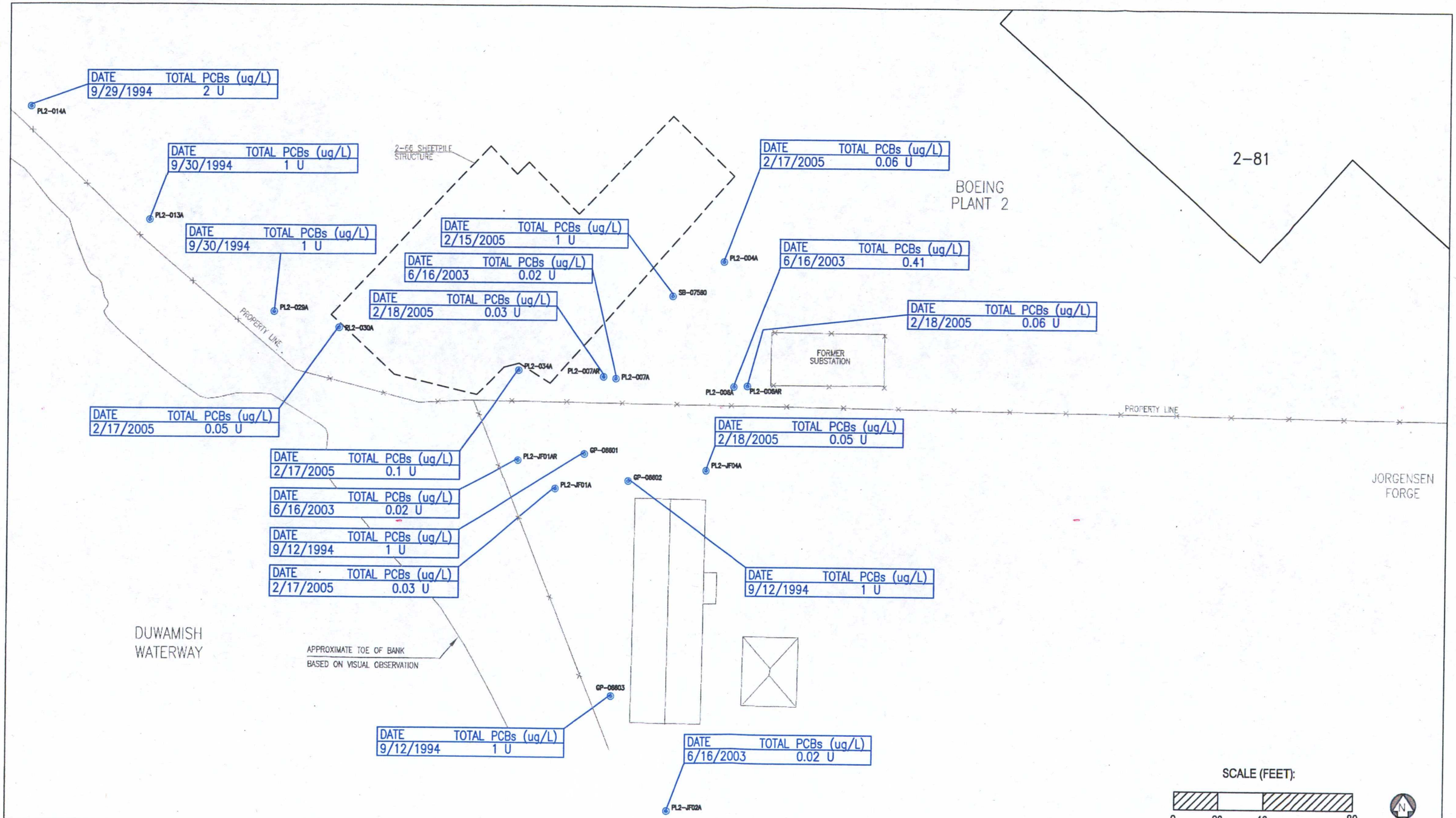
Figure 3.3
Isoconcentration Contours of Total PCBs in Soil
- Variation with Depth

DATE: 8/1/2005 11:18:51 AM
MXD NAME: \\Sam\Data\projects\Boeing - Plant 2\GIS\Phase II Trans Rpt\Figure 3.3 - Total PCB Iso.mxd

August 3, 2005



SCALE (FEET):

0 20 40 80

N

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

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BOEING PLANT 2
SEATTLE, WASHINGTON

WESTON SOLUTIONS
SEATTLE WASHINGTON

	CHECKED	DATE
DES. ENG.		
PROJ. ENG.		
PROJ. MGR.		
APPROVED		
APPROVED		

EXPLANATION OF DRAWING SYMBOLS

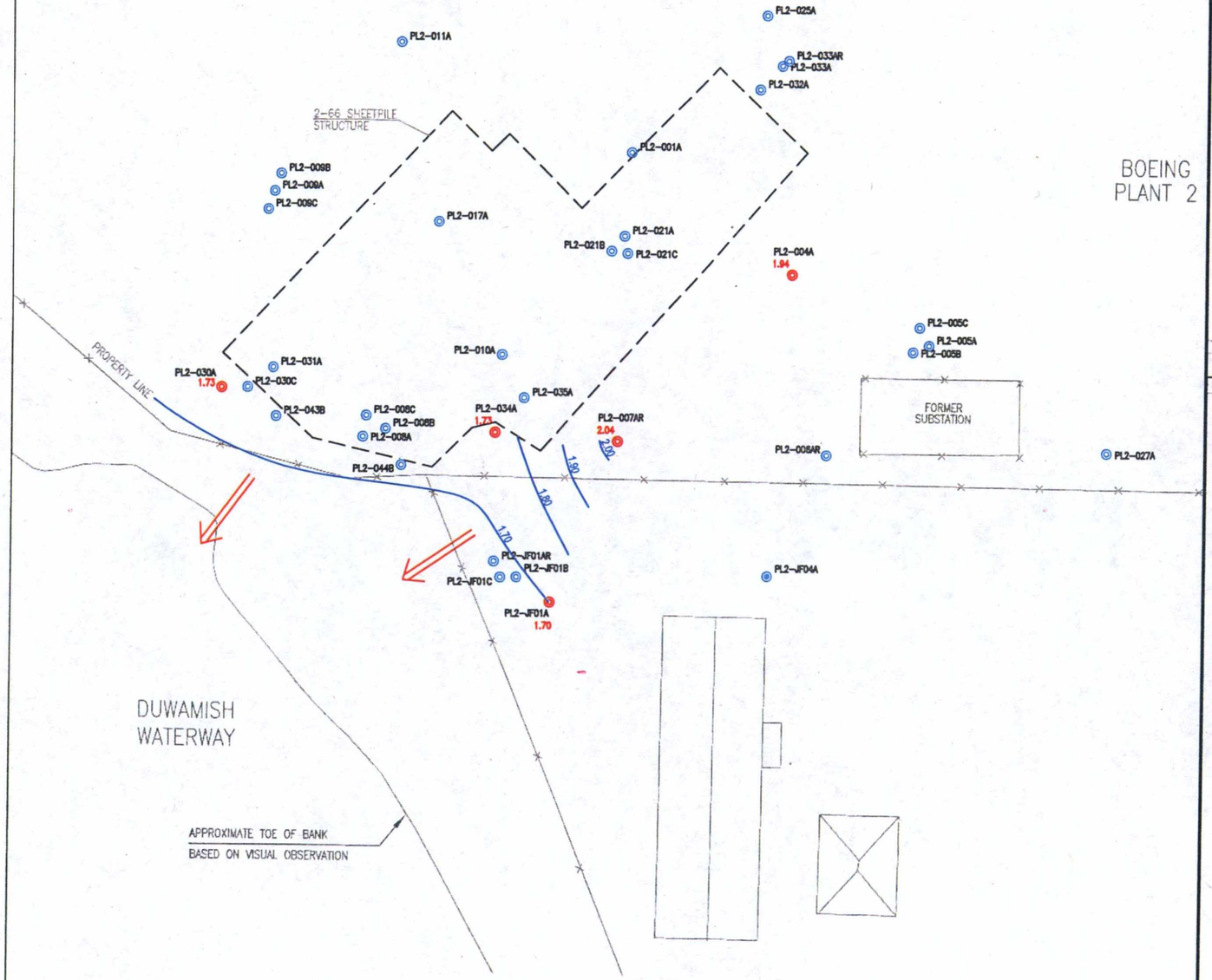
-X-X-	CHAIN LINK FENCE
PL2-006AR	WELL NAME
2/15/2005	SAMPLE DATE
J	VALUE IS AN ESTIMATE
U	NOT DETECTED ABOVE GIVEN DETECTION LIMIT
ug/L	MICROGRAMS PER LITER
⊕	STATION WITH HISTORICAL PCB DATA IN GROUNDWATER

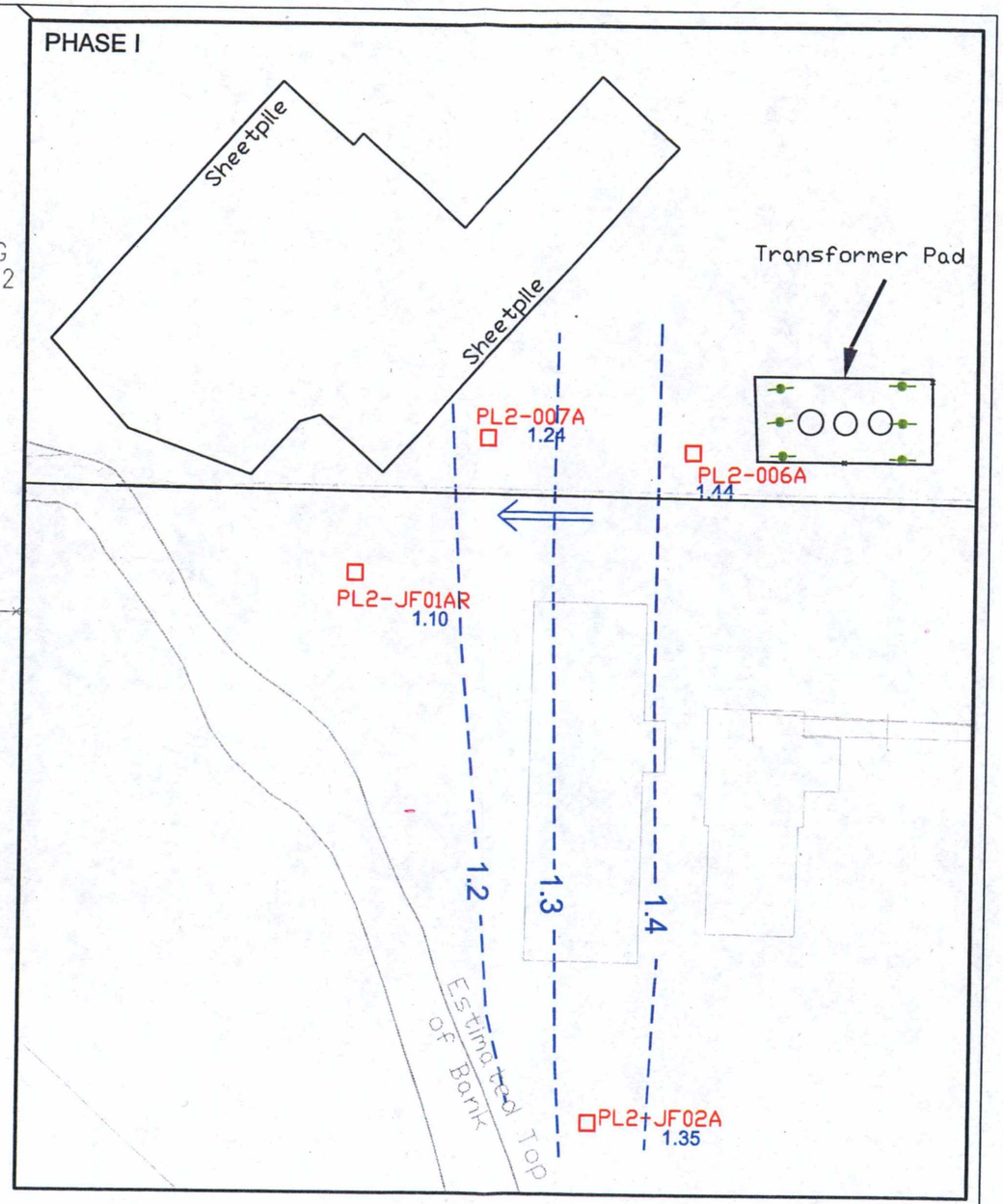
FIGURE 3.4
PHASE II AND PRIOR GROUNDWATER
TOTAL PCBs ANALYTICAL RESULTS

DRAWN: DLD	DATE: JULY 29, 2005	DWG. NO.: PL2-TPB	REV. NO.: 0
SCALE: 1" = 40'	W.O. NO.: 03709-079-001-0004 RPW NO. 05-0098	SHT. 1 OF 1	

PHASE II

PHASE I





NOTES:

1) PHASE I GROUNDWATER FLOW DIRECTION IS BASED ON 72-HOUR MEAN GROUNDWATER ELEVATIONS COLLECTED DURING A TRANSDUCER STUDY PERFORMED JUNE 2003 (FSM 2004).
2) PHASE II GROUNDWATER FLOW DIRECTION IS BASED ON 72-HOUR MEAN GROUNDWATER ELEVATIONS COLLECTED DURING A TRANSDUCER STUDY PERFORMED 14 THROUGH 18 MARCH 2005.

SCALE (FEET):

0 20 40 80

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

PHASE II TRANSFORMER PCB INVESTIGATION
BOEING PLANT 2
SEATTLE, WASHINGTON

WESTON SOLUTIONS
SEATTLE WASHINGTON

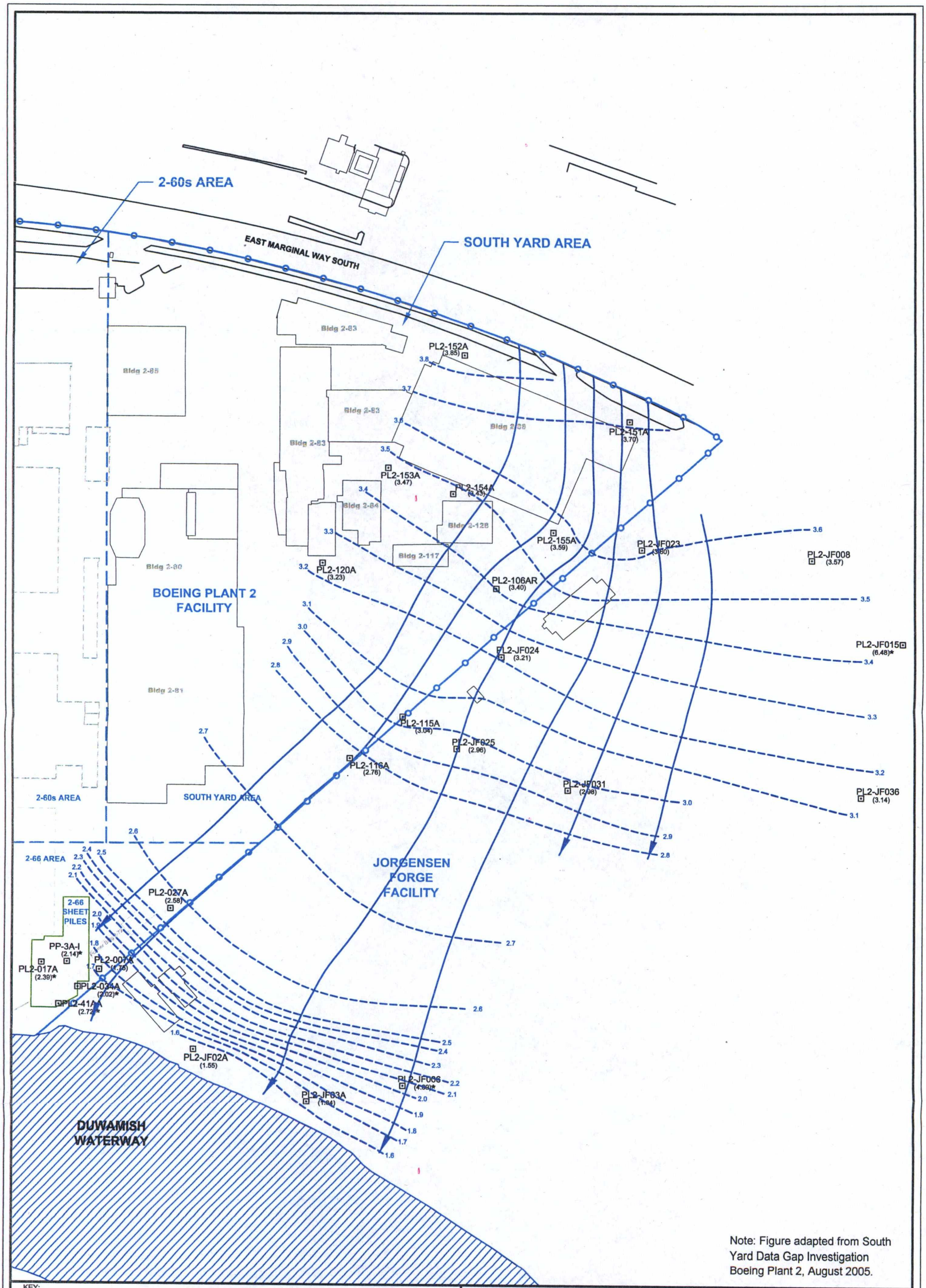
	CHECKED	DATE
DES. ENG.		
PROJ. ENG.		
PROJ. MGR.		
APPROVED		
APPROVED		

EXPLANATION OF DRAWING SYMBOLS

- CHAIN LINK FENCE
- PL2-035A EXISTING MONITORING WELLS
- PL2-034A 2.04 TRANSDUCER STUDY WELLS (ELEVATION NGVD 29)
- PHASE I 72-HOUR GROUNDWATER FLOW DIRECTION
- PHASE II 72-HOUR GROUNDWATER FLOW DIRECTION

FIGURE 3.5
MEAN GROUNDWATER ELEVATIONS AND POTENTIOMETRIC SURFACE
(PHASE I & PHASE II)

DRAWN	DATE	DWG. NO.	REV. NO.
DLD	JULY 29, 2005	PL2-TPB	0
SCALE 1" = 40'	W.O. NO. 03709-079-001-0004 RPM NO. 05-0098	SHT. 1 OF 1	



Note: Figure adapted from South Yard Data Gap Investigation Boeing Plant 2, August 2005.

KEY:

- MONITORING WELL WITH DATALOGGERS (GROUNDWATER ELEVATION IN FT. NGVD '29)
- GROUNDWATER ELEVATION CONTOURS (FT NGVD '29)
- GROUNDWATER FLOW DIRECTION
- PROPERTY BOUNDARY
- AREA BOUNDARY
- * ANOMALOUS VALUE, SEE REPORT TEXT

0 35 70 140

SCALE: 1" = 140'

ENVIRONMENTAL PARTNERS INC
295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

Figure 3.6

NET GROUNDWATER ELEVATION CONTOURS IN THE SOUTH YARD - JORGENSEN FORGE VICINITY
FEBRUARY 1, 2005 TO FEBRUARY 4, 2005

PROJECT	BOEING PLANT 2		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	7725 EAST MARGINAL WAY SEATTLE/TUKWILA, WASHINGTON		
SHEET 1 of 1	DRAWN BY TK	REVIEWED BY DCK	DATE 07/08/05

CB003 (INSERT)	2/16/2005
PCBs	ug/kg
AROCLOR 1242	840 U
AROCLOR 1248	840 U
AROCLOR 1254	1,900
AROCLOR 1260	2,300
Total	**4,200**

CB004 (BOTTOM)	2/16/2005
PCBs	ug/kg
AROCLOR 1242	410 U
AROCLOR 1248	410 U
AROCLOR 1254	900
AROCLOR 1260	1,100
Total	**2,000**

CB006 (INSERT)	2/17/2005
PCBs	ug/kg
AROCLOR 1242	75 U
AROCLOR 1248	75 U
AROCLOR 1254	520
AROCLOR 1260	560
Total	**1,080**

CB007 (BOTTOM)	2/17/2005
PCBs	ug/kg
AROCLOR 1242	38 U
AROCLOR 1248	38 U
AROCLOR 1254	38 U
AROCLOR 1260	38 U
Total	**38 U**

CB008 (NO INSERT)	2/17/2005
PCBs	ug/kg
AROCLOR 1242	130 U
AROCLOR 1248	130 U
AROCLOR 1254	420
AROCLOR 1260	340
Total	**760**

CB002	2/16/2005
PCBs	ug/kg
AROCLOR 1242	39,500
AROCLOR 1248	490 U
AROCLOR 1254	62,000
AROCLOR 1260	48,500
Total	**151,000**

SD005	5/3/2005
PCBs	ug/kg
AROCLOR 1242	1,400,000 U
AROCLOR 1248	1,400,000 U
AROCLOR 1254	10,000,000
AROCLOR 1260	1,400,000 U
Total	**10,000,000**

CB009 (6" C PIPE)	4/8/2005
PCBs	ug/kg
AROCLOR 1242	59,000 U
AROCLOR 1248	59,000 U
AROCLOR 1254	200,000 P
AROCLOR 1260	390,000
Total	**590,000**

CB005	2/17/2005
PCBs	ug/kg
AROCLOR 1242	190 U
AROCLOR 1248	190 U
AROCLOR 1254	190 U
AROCLOR 1260	1,400
Total	**1,400**

CB001	2/15/2005
PCBs	ug/kg
AROCLOR 1242	780 U
AROCLOR 1248	780 U
AROCLOR 1254	780 U
AROCLOR 1260	4,800
Total	**4,800**

CB010 (COMPOSITE)	4/8/2005
PCBs	ug/kg
AROCLOR 1242	8,000 U
AROCLOR 1248	39,000
AROCLOR 1254	40,000
AROCLOR 1260	8,000 U
Total	**79,000**

CB011 (TOP 9")	4/8/2005
PCBs	ug/kg
AROCLOR 1242	640 U
AROCLOR 1248	3,400
AROCLOR 1254	3,000
AROCLOR 1260	800
Total	**7,200**

CB012 (BOT. 3")	4/8/2005
PCBs	ug/kg
AROCLOR 1242	24,000 U
AROCLOR 1248	120,000
AROCLOR 1254	230,000
AROCLOR 1260	47,000 UY
Total	**350,000**

2-56 SHEETPILE STRUCTURE

BOEING PLANT 2

2-81

No.36-705 SDMH TYPE II 54" RIM = 12.40

12" C (ACTIVE)

12" C (EXPANSION PLUG INSERTED AT SDMH 36-63)

12" C

12" PVC (ACTIVE)

No.36-710 CB TYPE I RIM = 12.30 INV NE 12" 7.76

UNKNOWN PIPE 4"C PAST THIS POINT 6' DEEP AT MANHOLE

PIPE MATERIALS CHANGE FROM C TO CMP

PROPERTY LINE

8"CI

12" C

STORMWATER VAULT OUTLET CONNECTS TO 12"C HERE

FORMER SUBSTATION

AREA OF DISCOVERY

6" SIDE CONNECTION VISIBLE HERE, PLUGGED

VIDEO SURVEY STOPPED AT THIS POINT DUE TO DEBRIS IN PIPE PIPE DEPTH 8.5' HERE

12" C (INACTIVE)

6"CI

CONC TROUGH

12" CMP

24" CMP

APPROXIMATE LOCATION OF OBSERVED 24" CMP OUTFALL

VIDEO SURVEY STOPPED DUE TO HOLE IN PIPE

No.36-83 SDMH-I RIM 14.6

STORMWATER VAULT

PROPERTY LINE

12" C (INACTIVE)

SDMH 15A 9' TO BOTTOM (EXPANSION PLUG INSERTED)

SDMH 24A 10' 6" TO BOTTOM

12" C

LATERAL PIPE CONNECTING TO 24" C PIPE PLUGGED WITH LUMBER AT 8' 6" DEPTH

12" C (INACTIVE)

24" C (ACTIVE)

JORGENSEN FORGE

APPROXIMATE TOE OF BANK BASED ON VISUAL OBSERVATION

UNKNOWN PIPE 20" DEEP AT FENCE 3' DEEP AT MANHOLE PLUGGED WITH SOIL

DUWAMISH WATERWAY

SCALE (FEET):

0 20 40 80

N

NOTES:
1) PIPES SHOWN IN COLOR WERE INVESTIGATED USING A VIDEO CAMERA OR SNAKE/SONDE EQUIPMENT.

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

PHASE II TRANSFORMER PCB INVESTIGATION
BOEING PLANT 2
SEATTLE, WASHINGTON

WESTON SOLUTIONS
SEATTLE WASHINGTON

CHECKED
DES. ENG.
PROJ. ENG.
PROJ. MGR.
APPROVED
APPROVED
DATE

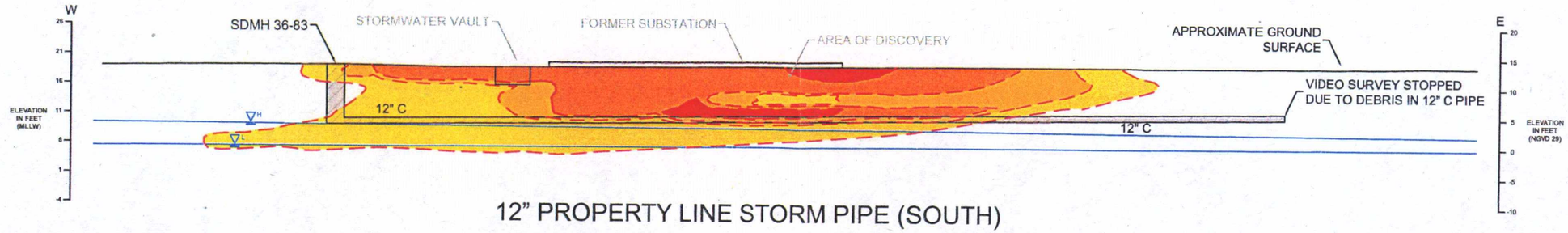
EXPLANATION OF DRAWING SYMBOLS

- CHAIN LINK FENCE
- MANHOLE (COLOR VARIES)
- C CONCRETE
- CMP CORRUGATED METAL PIPE
- PVC POLY VINYL CHLORIDE
- CI CAST IRON
- STORMWATER FLOW DIRECTION
- U NOT DETECTED ABOVE GIVEN DETECTION LIMIT
- Y DETECTION LIMIT ELEVATED DUE TO INTERFERENCES
- P POSITIVELY IDENTIFIED BUT WITH RPD > 40%
- CB001 SAMPLE IDENTIFER
- 2/15/2005 SAMPLE DATE

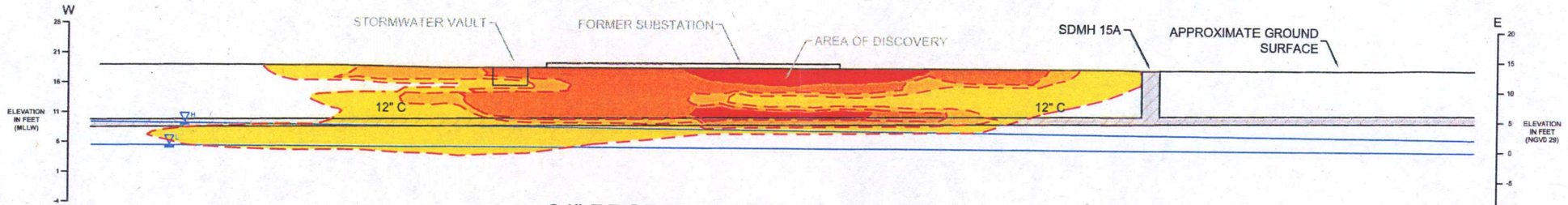
FIGURE 3.7
STORM SURVEY DETAILS AND PCB AROCLOR CONCENTRATIONS IN STORM SYSTEM SOLIDS SAMPLES

DRAWN	DATE	DWG. NO.	REV. NO.
DLD	JULY 29, 2005	BP2-TPB	0
SCALE 1" = 40'	W.O. NO. 03709-079-001-0004 RPT NO. 05-0098	SHT. 1 OF 1	

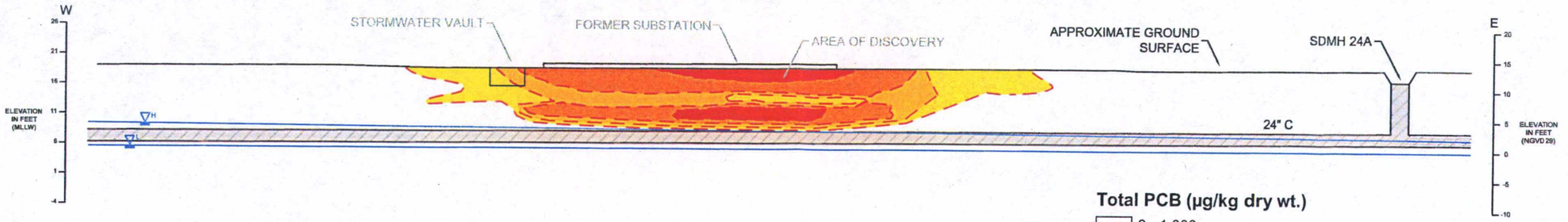
12" BOEING STORM PIPE (NORTH)



12" PROPERTY LINE STORM PIPE (SOUTH)



24" PROPERTY LINE STORM PIPE



Total PCB (µg/kg dry wt.)

- 0 - 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 100,000
- > 100,000

HORIZONTAL/VERTICAL SCALE (FEET):

0 10 20 40

NOTES:
1) GROUNDWATER ELEVATIONS SHOWN WERE INTERPRETED FROM MEASUREMENTS MADE DURING A 72-HOUR TRANSDUCER STUDY PERFORMED 14 THROUGH 18 MARCH 2005.
2) STORM PIPES WERE INVESTIGATED USING A VIDEO CAMERA OR SNAKE/SONDE EQUIPMENT. INVESTIGATION CONDUCTED BY WESTON IN FEBRUARY AND MAY 2005.
3) THE STORMWATER VAULT, FORMER SUBSTATION, AND AREA OF DISCOVERY ARE PROJECTED ONTO EACH PROFILE FOR REFERENCE ONLY.
4) PCB DISTRIBUTION BASED ON FIGURE 3.3.

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

PHASE II TRANSFORMER PCB INVESTIGATION
BOEING PLANT 2
SEATTLE, WASHINGTON

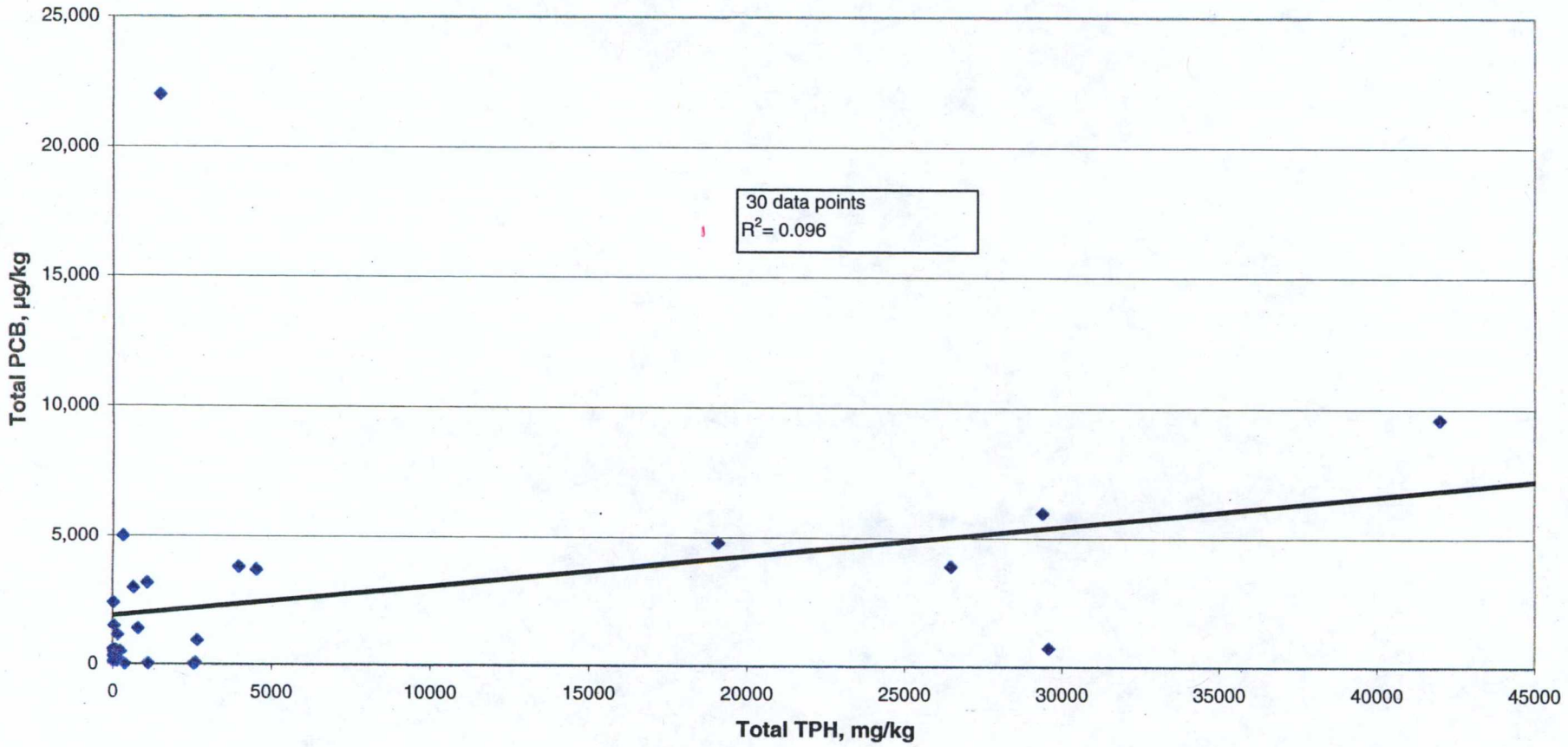
WESTON SOLUTIONS
SEATTLE WASHINGTON

	CHECKED	DATE
DES. ENG.		
PROJ. ENG.		
PROJ. MGR.		
APPROVED		
APPROVED		

EXPLANATION OF DRAWING SYMBOLS
C CONCRETE
H 72-HOUR HIGH GROUNDWATER ELEVATION
L 72-HOUR LOW GROUNDWATER ELEVATION
TOTAL PCBs CONCENTRATION CONTOURS (ug/kg)

FIGURE 3.8
SUBSURFACE PCB DISTRIBUTION
ALONG STORM PIPE ALIGNMENTS

DRAWN	DATE	DWG. NO.	REV. NO.
KMB	JULY 29, 2005	FIGURE 3-8	0
SCALE 1" = 20'	W.O. NO. 03709-079-001-0004 RFW NO. 05-0098	SHT. 1 OF 1	



Notes:

1. Data are plotted for samples with detected PCB concentrations that were also analyzed for TPH.
2. Total TPH is the sum of any and all fractions analyzed.

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Boeing Plant 2
Seattle, Washington

Figure 4.1
Correlation of Total PCB vs. Total TPH-
Current and Historical Data

F:\projects\Boeing - Plant 2\BOE-PL2 050 - SCLT\Phase II Report\Figures\Figure 4.1 072805.doc
August 3, 2005

NOTES:

1) Includes RFI, SW Bank, Area of Discovery, Phase I and Phase II data
2) Upland area contours less than 1,000 µg/kg not shown
3) The contours were generated using both surface and subsurface sediment and soil data. When multiple sample data at any station or exploration are available, the maximum total PCB concentration was used
4) Sediment Contour based on geospatial analysis protocols developed by the Geospatial Work Group (see text)

Boeing Plant 2

Outfall 11

Outfall 10

Outfall 9A (Abandoned)

Outfall 9

Property Line Outfalls

72"

24"

12"

Outfall 9

Outfall 008

Outfall 007

Outfall 006

Duwamish Waterway

Jorgensen Forge

N

0 70 140

Feet

Legend

- PCBs Detected
- PCBs Not Detected
- Sheet Pile
- Property Line
- Navigation Channel
- Waterway
- Building
- Transformer Pad

Total PCBs (µg/kg dry wt.)

- 0 - 130
- 130 - 500
- 500 - 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 100,000
- > 100,000

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Phase II Transformer PCB Investigation
Boeing Plant 2
Seattle, Washington

Figure 4.2
Isoconcentration Contours of
Maximum Total PCBs in Soil and Sediment

DATE: 8/1/2005 3:55:38 PM
MXD NAME: \\Sam\Data\projects\Boeing - Plant 2\GIS\Phase II Trans Rpt\Figure 4.2 - Max TPCB Iso.mxd

August 3, 2005

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Tables

August 3, 2005

Table 3.1
Soil Sampling Results

Location	Sample ID	Sample Date	Interval (feet bgs)		Total Petroleum Hydrocarbons (TPH-Dx) (mg/kg)						PCBs (µg/kg)																Total Organic Carbon (percent)
					Mineral Spirits		Diesel		Motor Oil		PCB Aroclors														Total PCBs		
											1016		1221		1232		1242		1248		1254		1260		Total		
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value
PL2-006AR	P2ST-SB-MW006AR-0080	2/16/2005	6	8	350		1,500		2,700	J	520	U	520	U	520	U	520	U	520	U	1,000	UY	3,700		3,700		
PL2-006AR	P2ST-SB-MW006AR-0100	2/16/2005	8	10	34	U	100		220	J	540	U	540	U	540	U	540	U	540	U	2,200	UY	5,000		5,000		
PL2-006AR	P2ST-SB-MW006AR-0120	2/16/2005	10	12	4,100		8,400		14,000	J	510	U	510	U	510	U	510	U	510	U	1,500	UY	3,900		3,900		
PL2-006AR	P2ST-SB-MW006AR-0140	2/16/2005	12	14	4,200		9,400		16,000	J	130	U	130	U	130	U	130	U	130	U	400	UY	730		730		
PL2-006AR	P2ST-SB-MW006AR-0160	2/16/2005	14	16	120		950		1,600	J	260	U	260	U	260	U	260	U	260	U	520	UY	940		940		
PL2-007AR	P2ST-SB-MW007AR-0080	2/16/2005	6	8	6.3	U	6	U	13	U	42	U	42	U	42	U	42	U	42	U	42	U	42	U	42	U	
PL2-007AR	P2ST-SB-MW007AR-0100	2/16/2005	8	10	6.8	U	6.8	U	14	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
PL2-007AR	P2ST-SB-MW007AR-0120	2/16/2005	10	12	6.8	U	6.8	U	14	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
PL2-007AR	P2ST-SB-MW007AR-0140	2/16/2005	12	14	6.9	U	6.9	U	19	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
PL2-007AR	P2ST-SB-MW007AR-0160	2/16/2005	14	16	6.4	U	6.4	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
PL2-JF04A	P2ST-SB-MWJF04A-0080	2/16/2005	6	8	15		7	U	14	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
PL2-JF04A	P2ST-SB-MWJF04A-0100	2/16/2005	8	10	34	U	34	U	70	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	0.49
PL2-JF04A	P2ST-SB-MWJF04A-0120	2/16/2005	10	12	33	U	140		390	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
PL2-JF04A	P2ST-SB-MWJF04A-0140	2/16/2005	12	14	32	U	32	U	65	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
PL2-JF04A	P2ST-SB-MWJF04A-0160	2/16/2005	14	16	6.6	U	6.6	U	14	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
PL2-JF04A	P2ST-SB-MWJF04A-0180	2/16/2005	16	18	6.5	U	11		26	J	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07229r	P2ST-SB-PP029-0080	2/14/2005	6	8	75		130		260	J	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	
SB-07229r	P2ST-SB-PP029-0100	2/14/2005	8	10	5.4	U	40		190	J	36	U	36	U	36	U	36	U	36	U	36	U	36	U	36	U	
SB-07229r	P2ST-SB-PP029-0120	2/14/2005	10	12	7	U	7	U	15	J	47	U	47	U	47	U	47	U	47	U	47	U	47	U	47	U	
SB-07229r	P2ST-SB-PP029-0140	2/14/2005	12	14	6.8	U	6.8	U	14	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07229r	P2ST-SB-PP029-0160	2/14/2005	14	16	6.6	U	6.6	U	13	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07230r	P2ST-SB-PP030-0080	2/14/2005	6	8	5.4	U	5.4	U	11	U	36	U	36	U	36	U	36	U	36	U	36	U	36	U	36	U	
SB-07230r	P2ST-SB-PP030-0100	2/14/2005	8	10	6	U	6.6		29	J	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	
SB-07230r	P2ST-SB-PP030-0120	2/14/2005	10	12	55		71		180	J	48	U	48	U	48	U	48	U	48	U	48	U	48	U	48	U	
SB-07230r	P2ST-SB-PP030-0140	2/14/2005	12	14	14		6.8		20	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07230r	P2ST-SB-PP030-0160	2/14/2005	14	16	6.7	U	6.7	U	13	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07231r	P2ST-SB-PP031-0080	2/14/2005	6	8	5.4	U	5.4	U	11	U	36	U	36	U	36	U	36	U	36	U	36	U	36	U	36	U	0.169
SB-07231r	P2ST-SB-PP031-0100	2/14/2005	8	10	5.9	U	6		34	J	39	U	39	U	39	U	39	U	39	U	39	U	39	U	39	U	
SB-07231r	P2ST-SB-PP031-0120	2/14/2005	10	12	6.9	U	6.9	U	25	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07231r	P2ST-SB-PP031-0140	2/14/2005	12	14	6.6	U	6.6	U	13	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07231r	P2ST-SB-PP031-0160	2/14/2005	14	16	6.7	U	6.7	U	19	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07232r	P2ST-SB-PP032-0080	2/14/2005	6	8	5.5	U	7.7	J	31	J	37	U	37	U	37	U	37	U	37	U	37	U	37	U	37	U	
SB-07232r	P2ST-SB-PP032-0100	2/14/2005	8	10	7.1	U	7.1	U	14	U	47	U	47	U	47	U	47	U	47	U	47	U	47	U	47	U	
SB-07232r	P2ST-SB-PP032-0120	2/14/2005	10	12	370		960		2400	J	49	U	49	U	49	U	49	U	49	U	49	U	49	U	49	U	
SB-07232r	P2ST-SB-PP032-0140	2/14/2005	12	14	240		650		1700	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07232r	P2ST-SB-PP032-0160	2/14/2005	14	16	230		1400		3700	J	44	U	44	U	44	U	44	U	44	U	44	U	88	UY	88	UY	
SB-07233r	P2ST-SB-PP033-0080	2/14/2005	6	8	2900		9000		19000	J	44	U	44	U	44	U	44	U	44	U	44	U	220	UY	220	UY	
SB-07233r	P2ST-SB-PP033-0100	2/14/2005	8	10	2200		7600		16000	J	44	U	88	UY	130	UY	88	UY	44	U	130	UY	220	UY	220	UY	
SB-07233r	P2ST-SB-PP033-0120	2/14/2005	10	12	6.9	U	7.7		21	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07233r	P2ST-SB-PP033-0140	2/14/2005	12	14	350		1400		3700	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07233r	P2ST-SB-PP033-0160	2/14/2005	14	16	32	U	310		870	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07247a	P2ST-SB-PP047-0020	2/14/2005	0	2	12	U	9		33	J	120	U	120	U	120	U	120	U	120	U	120	U	580		580		

Table 3.1
Soil Sampling Results

Location	Sample ID	Sample Date	Interval (feet bgs)		Total Petroleum Hydrocarbons (TPH-Dx) (mg/kg)						PCBs (µg/kg)																Total Organic Carbon (percent)
					Mineral Spirits		Diesel		Motor Oil		PCB Aroclors														Total PCBs		
											1016		1221		1232		1242		1248		1254		1260		Total		
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value
SB-07247a	P2ST-SB-PP047-0040	2/14/2005	2	4	11	U	5.5	U	11	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	
SB-07247a	P2ST-SB-PP047-0060	2/14/2005	4	6	12	U	6	U	12	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	
SB-07248	P2ST-SB-PP048-0020	2/14/2005	0	2	110	U	210		2400	J	36	U	36	U	36	U	36	U	36	U	71	UY	76		76		
SB-07248	P2ST-SB-PP048-0040	2/14/2005	2	4	7.8	U	5.5		18	J	37	U	37	U	37	U	37	U	37	U	37	U	37	U	37	U	
SB-07248	P2ST-SB-PP048-0060	2/14/2005	4	6	5.7	U	5.7	U	13	J	38	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	
SB-07248	P2ST-SB-PP048-0080	2/14/2005	6	8	6.8	U	7.1		23	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07248	P2ST-SB-PP048-0100	2/14/2005	8	10	6.2	U	9.3		28	J	42	U	42	U	42	U	42	U	42	U	42	U	42	U	42	U	
SB-07248	P2ST-SB-PP048-0120	2/14/2005	10	12	6.5	U	6.5	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07248	P2ST-SB-PP048-0140	2/14/2005	12	14	6.5	U	6.5	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07248	P2ST-SB-PP048-0160	2/14/2005	14	16	6.5	U	6.5	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07249	P2ST-SB-PP049-0020	2/15/2005	0	2	5.5	U	38		150	J	110	U	110	U	110	U	110	U	110	U	200		220	UY	200		
SB-07249	P2ST-SB-PP049-0040	2/15/2005	2	4	5.8	U	6.5		16	J	39	U	39	U	39	U	39	U	39	U	39	U	39	U	39	U	
SB-07249	P2ST-SB-PP049-0060	2/15/2005	4	6	6.6	U	6.6	U	8	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07249	P2ST-SB-PP049-0080	2/15/2005	6	8	6.6	U	6.6	U	6.6	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07249	P2ST-SB-PP049-0100	2/15/2005	8	10	5.9	U	5.9	U	5.9	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	
SB-07249	P2ST-SB-PP049-0120	2/15/2005	10	12	6.4	U	6.4	U	6.4	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07249	P2ST-SB-PP049-0140	2/15/2005	12	14	6.7	U	6.7	U	6.7	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07249	P2ST-SB-PP049-0160	2/15/2005	14	16	6.6	U	6.6	U	6.6	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07250	P2ST-SB-PP050-0020	2/14/2005	0	2	5.6	U	46		110	J	110	U	110	U	110	U	110	U	110	U	640		500	J	1140	J	
SB-07250	P2ST-SB-PP050-0040	2/14/2005	2	4	12		280		380	J	500	U	500	U	500	U	500	U	500	U	1000	UY	3000		3000		
SB-07250	P2ST-SB-PP050-0060	2/14/2005	4	6	6.5	U	6.5	U	13	U	43	U	43	U	43	U	43	U	43	U	86	UY	110		110		
SB-07250	P2ST-SB-PP050-0080	2/14/2005	6	8	6.7	U	6.7	U	20	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07250	P2ST-SB-PP050-0100	2/14/2005	8	10	8		98		140	J	44	U	44	U	44	U	44	U	44	U	180	UY	500		500		
SB-07250	P2ST-SB-PP050-0120	2/14/2005	10	12	6	U	6	U	12	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	40	U	
SB-07250	P2ST-SB-PP050-0140	2/14/2005	12	14	6.5	U	6.5	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07250	P2ST-SB-PP050-0160	2/14/2005	14	16	6.6	U	6.6	U	13	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07252	P2ST-SB-PP052-0020	2/15/2005	0	2							120	U	120	U	120	U	120	U	120	U	590	UY	490		490		
SB-07252	P2ST-SB-PP052-0040	2/15/2005	2	4							32	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	
SB-07253	P2ST-SB-PP053-0020	2/15/2005	0	2	11	U	19		110	J	36	U	36	U	36	U	36	U	36	U	36	U	130		130		
SB-07253	P2ST-SB-PP053-0040	2/15/2005	2	4	11	U	5.7	U	11	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	
SB-07253	P2ST-SB-PP053-0060	2/15/2005	4	6	11	U	5.7	U	11	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	
SB-07253	P2ST-SB-PP053-0080	2/15/2005	6	8	11	U	5.6	U	11	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	
SB-07253	P2ST-SB-PP053-0100	2/15/2005	8	10	12	U	6	U	12	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	33	U	
SB-07253	P2ST-SB-PP053-0120	2/15/2005	10	12	14	U	7.1	U	14	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	32	U	
SB-07560	P2ST-SB-PP060-0080	2/15/2005	6	8	5.7	U	5.7	U	5.7	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	
SB-07560	P2ST-SB-PP060-0100	2/15/2005	8	10	6.5	U	6.5	U	6.5	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07560	P2ST-SB-PP060-0120	2/15/2005	10	12	6.8	U	6.8	U	6.8	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07560	P2ST-SB-PP060-0140	2/15/2005	12	14	6.7	U	6.7	U	15	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07560	P2ST-SB-PP060-0160	2/15/2005	14	16	6.8	U	6.8	U	11	J	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07561	P2ST-SB-PP061-0080	2/14/2005	6	8	5.8	U	5.8	U	12	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	
SB-07561	P2ST-SB-PP061-0100	2/14/2005	8	10	6.8	U	6.8	U	14	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07561	P2ST-SB-PP061-0120	2/14/2005	10	12	7	U	7	U	14	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	

Table 3.1
Soil Sampling Results

Location	Sample ID	Sample Date	Interval (feet bgs)		Total Petroleum Hydrocarbons (TPH-Dx) (mg/kg)						PCBs (µg/kg)																Total Organic Carbon (percent)
					Mineral Spirits		Diesel		Motor Oil		PCB Aroclors														Total PCBs		
											1016		1221		1232		1242		1248		1254		1260		Total		
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value
SB-07561	P2ST-SB-PP061-0140	2/14/2005	12	14	6.7	U	6.7	U	21	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07561	P2ST-SB-PP061-0160	2/14/2005	14	16	6.8	U	7.2		14	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07562	P2ST-SB-PP062-0080	2/14/2005	6	8	5.7	U	5.7	U	11	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U	
SB-07562	P2ST-SB-PP062-0100	2/14/2005	8	10	9.4	U	6.4	U	35	J	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07562	P2ST-SB-PP062-0120	2/14/2005	10	12	6.4	U	6.4	U	13	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	43	U	
SB-07562	P2ST-SB-PP062-0140	2/14/2005	12	14	6.8	U	7.1		34	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07562	P2ST-SB-PP062-0160	2/14/2005	14	16	6.6	U	6.6	U	16	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07563	P2ST-SB-PP063-0080	2/14/2005	6	8	13	U	34		72	J	40	U	40	U	40	U	40	U	40	U	80	UY	160		160		
SB-07563	P2ST-SB-PP063-0100	2/14/2005	8	10	6.6	U	6.8		37	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	
SB-07563	P2ST-SB-PP063-0120	2/14/2005	10	12	6.8	U	6.8	U	22	J	45	U	45	U	45	U	45	U	45	U	45	U	45	U	45	U	
SB-07563	P2ST-SB-PP063-0140	2/14/2005	12	14	6.8	U	6.8	U	14	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	46	U	
SB-07563	P2ST-SB-PP063-0160	2/14/2005	14	16	6.6	U	6.6	U	22	J	44	U	44	U	44	U	44	U	44	U	44	U	44	U	44	U	

Notes:

bgs Below ground surface.

J The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.

U Indicates the compound was undetected at the reported concentration.

UY Indicates a raised reporting limit due to matrix interferences.

Table 3.2
Groundwater Sampling Results

Location	Sample ID	Sample Date	Total Petroleum Hydrocarbons (TPH-Dx) (mg/L)						PCBs (µg/L)																Total Organic Carbon (mg/L)
			Mineral Spirits		Diesel		Motor Oil		PCB Aroclors														Total PCBs		
									1016		1221		1232		1242		1248		1254		1260		Total		
			Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value
PL2-004A	P2ST-GW-MW004A-0000	2/17/2005	0.25	U	0.25	U	0.25	U	0.025	UY	0.01	U	0.06	UY	0.035	UY	0.025	UY	0.01	U	0.01	U	0.06	UY	14.3
PL2-006AR	P2ST-GW-MW006AR-0000	2/18/2005	2.7		2.7		0.47		0.025	UY	0.01	U	0.06	UY	0.03	UY	0.03	UY	0.04	UY	0.025	UY	0.06	UY	14.9
PL2-007AR	P2ST-GW-MW007AR-0000	2/18/2005	0.25	U	0.25	U	0.25	U	0.025	UY	0.01	U	0.03	UY	0.03	UY	0.025	UY	0.025	UY	0.03	UY	0.03	UY	4.13
PL2-030A	P2ST-GW-MW030A-0000	2/17/2005	0.25	U	0.25	U	0.25	U	0.05	UY	0.01	U	0.01	U	0.04	UY	0.05	UY	0.01	U	0.01	U	0.05	UY	7.03
PL2-034A	P2ST-GW-MW034A-0000	2/17/2005	0.25	U	0.25	U	0.25	U	0.01	U	0.1	UY	0.045	UY	0.02	UY	0.065	UY	0.02	UY	0.01	UY	0.1	UY	5.59
PL2-JF01A	P2ST-GW-MWJF01A-0000	2/17/2005	0.25	U	0.27		0.25	U	0.015	UY	0.01	U	0.03	UY	0.02	UY	0.025	UY	0.015	UY	0.01	U	0.03	UY	13
PL2-JF01A[1]	P2ST-GW-MWJF01A-1000	2/17/2005	0.25	U	0.26		0.25	U	0.02	UY	0.01	U	0.035	UY	0.025	UY	0.025	UY	0.015	UY	0.01	U	0.035	UY	13
PL2-JF04A	P2ST-GW-MWJF04A-0000	2/18/2005	0.35		0.73		0.5	U	0.02	UY	0.01	U	0.05	UY	0.03	UY	0.04	UY	0.01	U	0.015	UY	0.05	UY	11.7
SB-07560	P2ST-GW-PP060-0000	2/15/2005	0.25	U	0.6		0.5	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	1	U	13.8

Notes:

1 Duplicate sample.

U Indicates the compound was undetected at the reported concentration.

UY Indicates a raised reporting limit due to matrix interferences.

Table 3.3
Storm Solids Sampling Results for PCBs and TPH

Manhole ID and Location	Sample ID	Location Description	Sample Date	Total Petroleum Hydrocarbons (mg/kg)						PCBs (µg/kg)															
										PCB Aroclors														Total PCBs	
				Mineral Spirits		Diesel		Motor Oil		1016		1221		1232		1242		1248		1254		1260		Total	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
CB001	P2ST-GR-CB001-0000	Concrete trough	2/15/2005							780	U	780	U	780	U	780	U	780	U	780	U	4,800		4,800	
CB002	P2ST-GR-CB002-0000	MH 36-83 bottom	2/16/2005							490	U	490	U	490	U	40,000		490	U	76,000		49,000		165,000	
CB003	P2ST-GR-CB003-0000	CB 36-709 insert	2/16/2005							840	U	840	U	840	U	840	U	840	U	1,900		2,300		4,200	
CB004	P2ST-GR-CB004-0000	CB 36-709 bottom	2/16/2005							410	U	410	U	410	U	410	U	410	U	900		1,100		2,000	
CB005	P2ST-GR-CB005-0000	Storm Water Vault	2/17/2005							190	U	190	U	190	U	190	U	190	U	190	U	1,400		1,400	
CB006	P2ST-GR-CB006-0000	MH 36-705 insert	2/17/2005							75	U	75	U	75	U	75	U	75	U	520		560		1,080	
CB007	P2ST-GR-CB007-0000	MH 36-705 bottom	2/17/2005							38	U	38	U	38	U	38	U	38	U	38	U	38	U	38	U
CB008	P2ST-GR-CB008-0000	CB 36-710 bottom	2/17/2005							130	U	130	U	130	U	130	U	130	U	420		340		760	
CB009	P2ST-GR-CB009-0000	6-inch pipe into MH 36-83	4/8/2005							59,000	U	59,000	U	59,000	U	59,000	U	59,000	U	200,000	J	390,000		590,000	J
CB010	P2ST-GR-CB010-0000	MH 15A along 12" storm pipe on JF: composite sample from top and bottom layers	4/8/2005	57	U	220		680	J	440	U	440	U	440	U	440	U	39,000		40,000		8,800	UY	79,000	
CB011	P2ST-GR-CB011-0000	MH 15A along 12" storm pipe on JF: sample from top 9" layer of slag/gravel atop sand layer at base of manhole	4/8/2005	11	U	42		160	J	210	U	210	U	210	U	210	U	3,400		3,000		1,000		7,400	
CB012	P2ST-GR-CB012-0000	MH 15A along 12" storm pipe on JF: sample from 3" sand layer at base of manhole	4/8/2005	12	U	180		440	J	24,000	U	24,000	U	24,000	U	24,000	U	120,000		230,000		47,000	UY	350,000	
SD001[1]	P2SC-GR-SD001-0000	MH 37-2 along 24" storm pipe on JF	5/2/2005	130	U	4,400	J	9,600	J	260,000	U	260,000	U	260,000	U	260,000	U	770,000	UY	2,600,000		260,000	U	2,600,000	
SD002[1]	P2SC-GR-SD002-0000	MH 37-7 along side-branch leading from Boeing to 24" line on JF	5/3/2005	29	U	430	J	1,100	J	86,000	U	86,000	U	86,000	U	86,000	U	86,000	U	730,000		86,000	U	730,000	
SD003[1]	P2SC-GR-SD003-0000	MH 15B along 12" storm pipe on JF at junction with pipe coming in from Boeing	5/3/2005	120	U	1,000	J	4,600	J	17,000	U	17,000	U	17,000	U	17,000	U	17,000	U	140,000		17,000	U	140,000	
SD004[1]	P2SC-GR-SD004-0000	MH 24B along 24" storm pipe on JF	5/3/2005	56	U	1,800	J	4,700	J	320,000	U	320,000	U	320,000	U	320,000	U	320,000	U	2,400,000		320,000	U	2,400,000	
SD005	P2ST-GR-SD005-0000	MH 24A along 24" storm pipe on JF; immediately downstream from 12-inch pipe leading in from JF (last MH prior to river discharge)	5/3/2005	270	U	4,400		3,500		1,400,000	U	1,400,000	U	1,400,000	U	1,400,000	U	1,400,000	U	10,000,000		1,400,000	U	10,000,000	
SD006[1]	P2SC-GR-SD006-0000	"Public" MH along 24" storm pipe at NE corner of Jorgensen Forge, just outside of Jorgensen fence line. Ending point for video survey	6/2/2005	240	U	120	U	490		960	U	960	U	960	U	960	U	960	U	68,000		960	U	68,000	

Notes:

1 Sample collected outside of Transformer Investigation Area for broader source control purposes. Sample locations not shown or results not discussed within text.
J The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.
MH Manhole.
U Indicates the compound was undetected at the reported concentration.
UY Indicates a raised reporting limit due to matrix interferences.

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Appendix A
Investigation Methodology and Exploration Logs

August 3, 2005

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1.0 Subsurface Soil Sampling

Subsurface soil samples were collected from 19 locations (16 explorations and three borings [monitoring wells were later installed in the borings]). Samples were collected at 2-foot depth intervals using either push-probe methods (explorations) or hollow-stem auger (borings) methods to a depth of 16 feet below ground surface (bgs). The borings were advanced to slightly greater depths (no deeper than 18 feet bgs) to meet monitoring well construction specifications. A Weston geologist logged the soil using methods described in the RFI Work Plan (Weston 1994).

The soil was homogenized from each 2-foot interval and placed into sample containers using dedicated stainless steel bowls and spoons. All field samples were screened using a photo ionization detector (PID).

1.1 PUSH-PROBE METHOD

Subsurface explorations were advanced using push-probe methods. Undisturbed subsurface soil samples were collected from these explorations in 4-foot intervals using non-dedicated 1.5-inch outside diameter stainless steel samplers lined with single-use plastic liners. The retrieved liner was spilt open lengthwise exposing the soil core, which was then examined, logged, and sampled. Two distinct samples were collected from each 4-foot interval (e.g., samples from 4 to 6 feet and 6 to 8 feet in the 4- to 8-foot interval).

1.2 HOLLOW-STEM AUGER METHOD

Subsurface borings were advanced using hollow-stem auger methods. Subsurface soil samples were collected from these borings in 2-foot intervals using non-dedicated split-spoon samplers driven by a 140-pound hammer. One sample was collected from each interval. Monitoring wells were later installed in each boring (refer to discussion on monitoring well installation below).

2.0 Well installation, Development, and Abandonment

One new monitoring well (PL2-JF004A) and two replacement wells (PL2-006AR and PL2-007AR) were installed as part of the Phase II Investigation. Monitoring wells PL2-006A and PL2-007A were abandoned as part of the monitoring well activities.

The monitoring wells were installed using a limited access hollow-stem auger rig in accordance with the Washington State Department of Ecology (Ecology) Minimum Standards for Construction and Maintenance of Wells [173-160 WAC] and Weston Standard Operating Procedures (SOPs) 4.3. Well casings and screens were constructed of 2-inch diameter, Schedule-40 PVC. Each well had a ten-foot long, 0.010-inch slotted pre-packed well screen. A filter pack of 10-20 silica sand was placed from the bottom of the well screen to a depth of 2 feet above the top of the well screen. A bentonite chip seal was placed immediately above the sand pack to a depth of 2 feet bgs. The well was sealed with a concrete surface housing. A heavy-duty flush mount well monument and locking well cap completed the installation.

The new wells were developed using an inertia pump with dedicated poly tubing and a check ball valve. Development continued until the water produced was clear and free of sediment with turbidity less than 5 nephelometric turbidity units (NTU). Well development logs are included in Appendix C. Development was conducted in accordance with Weston SOPs 4.4.

All monitoring well installation, development, and abandonment activities were conducted in accordance with the Phase II Transformer PCB Investigation Work Plan (Floyd|Snider et al. 2004) and Washington State regulations.

3.0 Station Location Survey

The exploration locations were surveyed by a professional licensed surveyor to establish the northing and easting (for the wells), and the casing elevation (Table A.1). All horizontal locations were surveyed to the approximate center of the monitoring well casing. Elevation measurements were taken on the north side of the PVC riser. Horizontal and vertical datum are based on Washington State Plane Coordinate System, North Zone (North American Datum 1983) and North American Vertical Datum of 1929 (NAVD 29), respectively, to an accuracy of ± 0.01 feet.

4.0 Groundwater Sampling

As part of this investigation, groundwater samples were collected from monitoring wells PL2-004A, PL2-006AR, PL2-007AR, PL2-030A, PL2-034A, PL2-JF01A, and PL2-JF04A using a low-flow well sampling approach. The wells were purged and sampled with a peristaltic pump according to Weston SOPs 1.10. The low flow method is preferred because it creates less disturbance and agitation to the well, and therefore excess turbidity is not generated during the purging and sampling process. The result is more rapid stabilization of turbidity and other field parameters hence a sample which is more representative of conditions in the formation.

Water quality parameters (i.e., pH, temperature, redox potential, dissolved oxygen [DO], conductivity, and turbidity) were monitored and recorded during purging. Purging continued until water quality parameters stabilized. Stabilization was considered complete when three consecutive readings, taken at 3-minute intervals, were within the following criteria: pH (± 0.1 unit), specific conductance (± 3%), DO (± 10%), and turbidity (less than 5 NTU). Field data sheets showing water quality parameters collected during purging are included in Appendix C.

Groundwater samples were collected using the peristaltic pump discharging directly into pre-cleaned sample containers. The samples were placed in iced coolers to await transport to the laboratory.

5.0 Storm Drain Solids Sampling

Storm drain solids samples were successfully collected from all locations identified in the Work Plan. Samples were collected by either entering the manholes (under confined space protocols) and using a hand-held stainless steel spoon to collect solids from the bottom of the structure, or by reaching into the manholes and catch basins using a stainless steel spoon attached to a 10-foot rod. When present, separate samples were collected and the catch basins were fitted with stainless steel inserts, one from the bottom of the catch basin, and the second from solids within the inserts.

6.0 Decontamination

Decontamination procedures were conducted according to the following procedure on all non-dedicated sampling equipment: water rinse, Simple Green® All-Purpose Cleaner wash, deionized water rinse, and dry. Sampling equipment that was not immediately used was wrapped in aluminum foil.

7.0 Water Level Measurements

Water levels in monitoring wells were recorded using a combination of pressure transducers with internal data loggers and an electronic water level indicator. Pressure transducers measure and record the pressure of the water column above the transducer. The data logger was programmed to automatically convert pressure changes to water levels, assuming freshwater density conditions.

The general procedure for recording water levels in the monitoring wells is summarized below.

1. At each of the monitoring well locations, a pressure transducer was lowered into the well and securely fastened to the top of the well casing for the duration of the monitoring period. A locking metal box was placed above each monitoring well and secured to the pavement to limit access to the monitoring wells and the instruments.
2. The transducers were set to record the height of water column above the transducer at 5-minute intervals.
3. The pressure transducers were rated to a minimum 15 pounds per square inch (psi) range capable of measuring water level change of about 23 feet with a resolution of 0.001 foot.
4. Periodic depth-to-water level measurements to the nearest 0.01 foot were made with a manual electronic water level indicator from a surveyed reference point at the top of the well casing. The water level data was converted to groundwater elevation (feet NGVD 29). Manual depth-to-water level measurements were performed in each monitoring well five times during the monitoring period.
5. At the end of the data collection period the transducers were removed and the water level data was uploaded to a computer.

7.1 DATA ANALYSIS

The water level data was evaluated using the general procedures described below.

7.1.1 Observed Hydraulic Head

Pressure transducer readings were converted to observed hydraulic head. Hydraulic head measurements are expressed as an elevation above a given datum.

The observed hydraulic head or groundwater elevation is expressed as:

$$H_o = E - h_w$$

where:

H_o = observed hydraulic head under existing field conditions (feet NGVD 29).
E = elevation of the surface control datum from which field measurements is made (feet NGVD 29).
h_w = depth to fluid column surface within the piezometer or borehole (feet).

For example, assuming a top of casing elevation of 13 feet and a depth to water of 10 feet the observed hydraulic head is 3 feet.

The following procedure was used to determine the observed hydraulic heads in a series of water column heights obtained from transducer readings. The first step is to determine a reference hydraulic head during the monitoring period. The reference hydraulic head is represented by the following equation:

$$H_{oj} = E - h_{wj}$$

where:

H_{oj} = observed hydraulic head at time j (feet)
H_w = calibration measurement depth to water level from the top of casing at time j (feet)

The next step is to determine the hydraulic head at other times during the monitoring period from changes in the height of the water column recorded by the transducer relative to the reference hydraulic head. This is represented by the following relationship:

$$H_{oj+a} = H_{oj} - (h_{cj} - h_{cj+a})$$

where:

H_{oj+a} = observed hydraulic head at time j plus time interval a (feet)
H_{cj+a} = height of water column above transducer at time j plus time interval a (feet)
a = sampling interval (time)

Assuming an initial hydraulic head (H_{oj}) of 3 feet and an increase in the height of the water column of 1 foot (h_{cj}-h_{cj+ai}), the observed hydraulic head at time j+a is 4 feet.

7.2 GROUNDWATER ELEVATIONS

Mean groundwater elevations were calculated using the method described by Serfes (1991). This method uses a 72-hour set of hourly observed hydraulic heads to filter out the dominant tidal fluctuations to determine a mean groundwater elevation.

Let the consecutive hourly water levels be O(1), O(2), O(3).....,O(71), then the first sequence of moving means (X_i) is calculated from:

$$X_i = \sum_{K=0}^{23} \frac{O(K+i)}{24} \text{ where i = 1,2,3,...48;}$$

and the second sequence of moving means (Yj) is the calculated from:

$$Y_i = \sum_{i=0}^{23} \frac{X(i+j)}{24} \text{ where j = 1,2,3,..25.}$$

Finally, the mean groundwater elevation (M) is calculated as the arithmetic mean of the second sequence of moving means:

$$M = \sum_{j=1}^{23} \frac{Yj}{25}$$

M represents the mean groundwater level at hour 36.

7.3 RESULTS

Water levels monitoring was conducted in five wells from March 14 through March 18, 2005 for approximately 93 hours.

8.0 References

Floyd|Snider and Weston Solutions, Inc (Weston). 2004. *Phase II Transformer PCB Investigation Work Plan.* Prepared for The Boeing Company. November.

Serfes, M.E. 1991. *Determining the Mean Hydraulic Gradient of Ground Water Affected by Tidal Fluctuations.* Ground Water 29(4): 549-555.

Weston Solutions, Inc. (Weston). 1994. *RCRA Facility Investigation Work Plan, Boeing Plant-2, Seattle/Tukwila, Washington.* November.

Tables

Table A.1
Station Location Survey Data

Station ID	Northing[1] (X)	Easting[2] (Y)*	Elevation (Z)	Comment
SB-07229r	195774.856	1275947.315	14.312	SCL Phase II Soil Exploration
SB-07230r	195771.456	1275978.099	14.277	SCL Phase II Soil Exploration
SB-07231r	195735.527	1275979.327	14.655	SCL Phase II Soil Exploration
SB-07232r	195751.078	1275934.509	14.343	SCL Phase II Soil Exploration
SB-07233r	195764.551	1275936.567	14.349	SCL Phase II Soil Exploration
SB-07247a	195809.045	1276081.997	13.469	SCL Phase II Soil Exploration
SB-07248	195811.26	1276056.204	13.341	SCL Phase II Soil Exploration
SB-07249	195792.416	1276045.603	13.958	SCL Phase II Soil Exploration
SB-07250	195792.446	1276025.017	13.993	SCL Phase II Soil Exploration
SB-07251	195791.766	1276080.101	14.244	SCL Phase II Soil Exploration
SB-07252	195783.951	1276068.456	14.235	SCL Phase II Soil Exploration
SB-07253	195769.184	1276030.978	14.315	SCL Phase II Soil Exploration
SB-07560	195855.144	1275906.634	12.972	SCL Phase II Soil Exploration
SB-07561	195863.586	1275863.831	12.527	SCL Phase II Soil Exploration
SB-07562	195835.695	1275879.601	12.684	SCL Phase II Soil Exploration
SB-07563	195845.596	1275850.774	12.347	SCL Phase II Soil Exploration
PL2-006AR	195814.993	1275941.14	12.86	Replacement Monitoring Well
PL2-007AR	195818.774	1275875.321	12.67	Replacement Monitoring Well
PL2-JF04A	195776.926	1275922.707	14.48	Replacement Monitoring Well

Notes:

1 Vertical Datum is based on North American Vertical Datum of 1929 (NAVD 29).

2 Horizontal Datum is based on Washington State Plane Coordinate System, North Zone (North American Datum 1983).

* Horizontal locations were surveyed to the approximate center of the monitoring well casing.

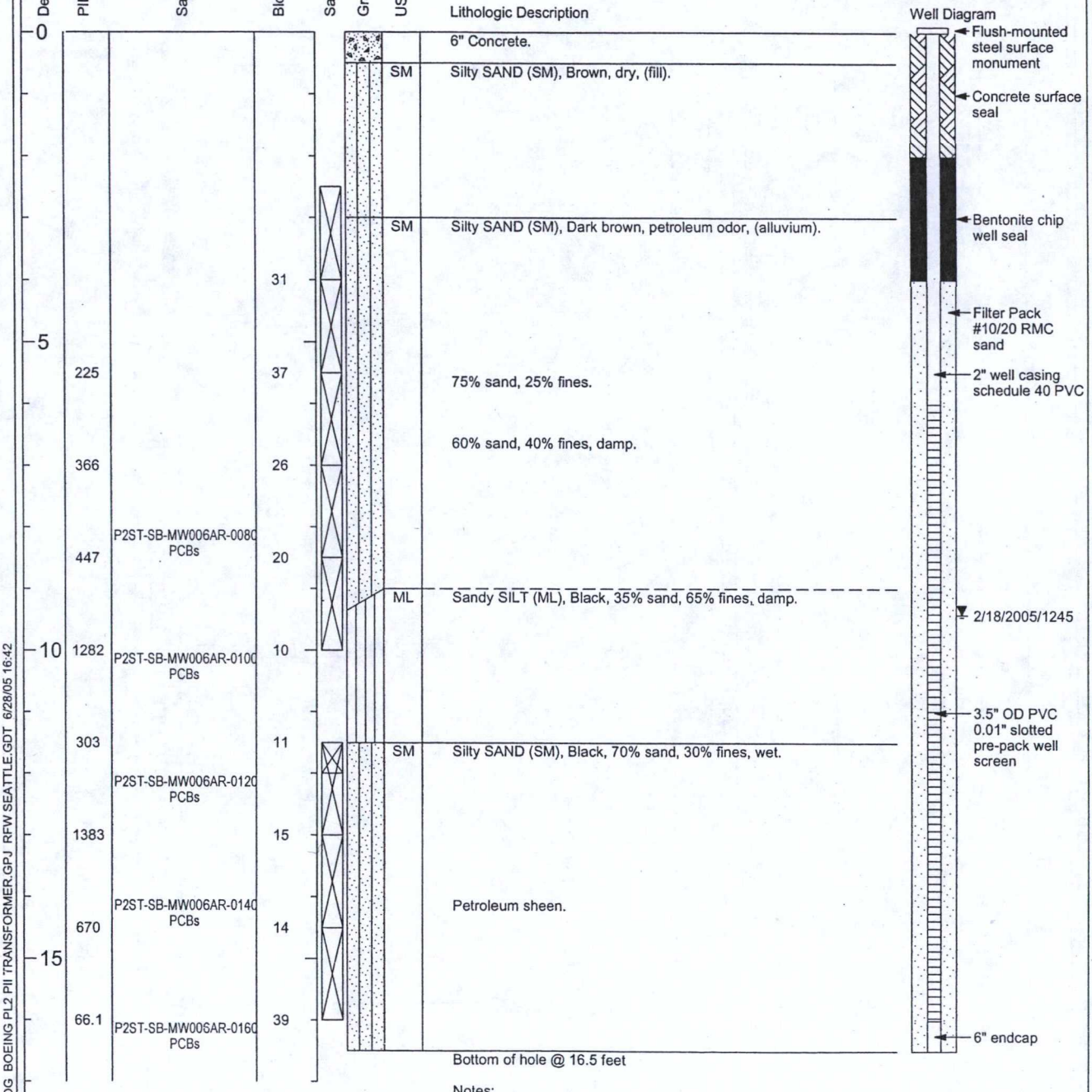
Table A.2
Groundwater Elevations (feet NGVD 29)

Well Numbers	Mean Groundwater Elevation	Groundwater Elevation at 3/16/05 08:37 (high tide)	Groundwater Elevation at 3/15/05 14:55 (low tide)
PL2-004A	1.94	2.897	0.398
PL2-007AR	2.04	3.440	-0.468
PL2-030A	1.73	3.608	-1.601
PL2-034A	1.73	3.645	-1.723
PL2-JF01A	1.70	3.871	-2.396

Boring Logs

Monitoring Well PL2-006AR

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 16, 2005
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEV (ft) 12.86 feet NGVD29
GROUND SURFACE ELEV (ft) -
LOGGED BY K. Broom (Weston)



Notes:
Replaces monitoring well PL2-006A.

Plate
A-1

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Monitoring Well PL2-007AR

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 16, 2005
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEV (ft) 12.67 feet NGVD29
GROUND SURFACE ELEV (ft) -
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							6" Concrete.
			31			SM	Silty SAND (SM), Brown, 85% sand, 15% fines, dry, (fill).
5	0		23			SM	Silty SAND (SM), Brown, 70% sand, 30% fines, (alluvium).
	0		28				60% sand, 40% fines.
	0	P2ST-SB-MW007AR-0080 PCBs	19				35% sand, 65% fines, wet.
10	0	P2ST-SB-MW007AR-0100 PCBs	18				
	0	P2ST-SB-MW007AR-0120 PCBs	12			SM	Silty SAND (SM), Dark brown, 70% sand, 30% fines, damp.
	0		18				wet.
	0	P2ST-SB-MW007AR-0140 PCBs	34				
15	0	P2ST-SB-MW007AR-0160 PCBs	14				
							Bottom of hole @ 17.5 feet

Notes:
Replaces monitoring well PL2-007A.

Well Diagram

- Flush-mounted steel surface monument
- Concrete surface seal
- Bentonite chip well seal
- Filter Pack #10/20 RMC sand
- 2" well casing schedule 40 PVC
- 2/18/2005/0838
- 3.5" OD PVC 0.01" slotted pre-pack well screen
- 6" endcap

Plate
A-2

Monitoring Well PL2-JF04A

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 16, 2005
DRILLING METHOD Hollow Stem Auger
TOP OF CASING ELEV (ft) 14.48 feet NGVD29
GROUND SURFACE ELEV (ft) -
LOGGED BY K. Broom (Weston)

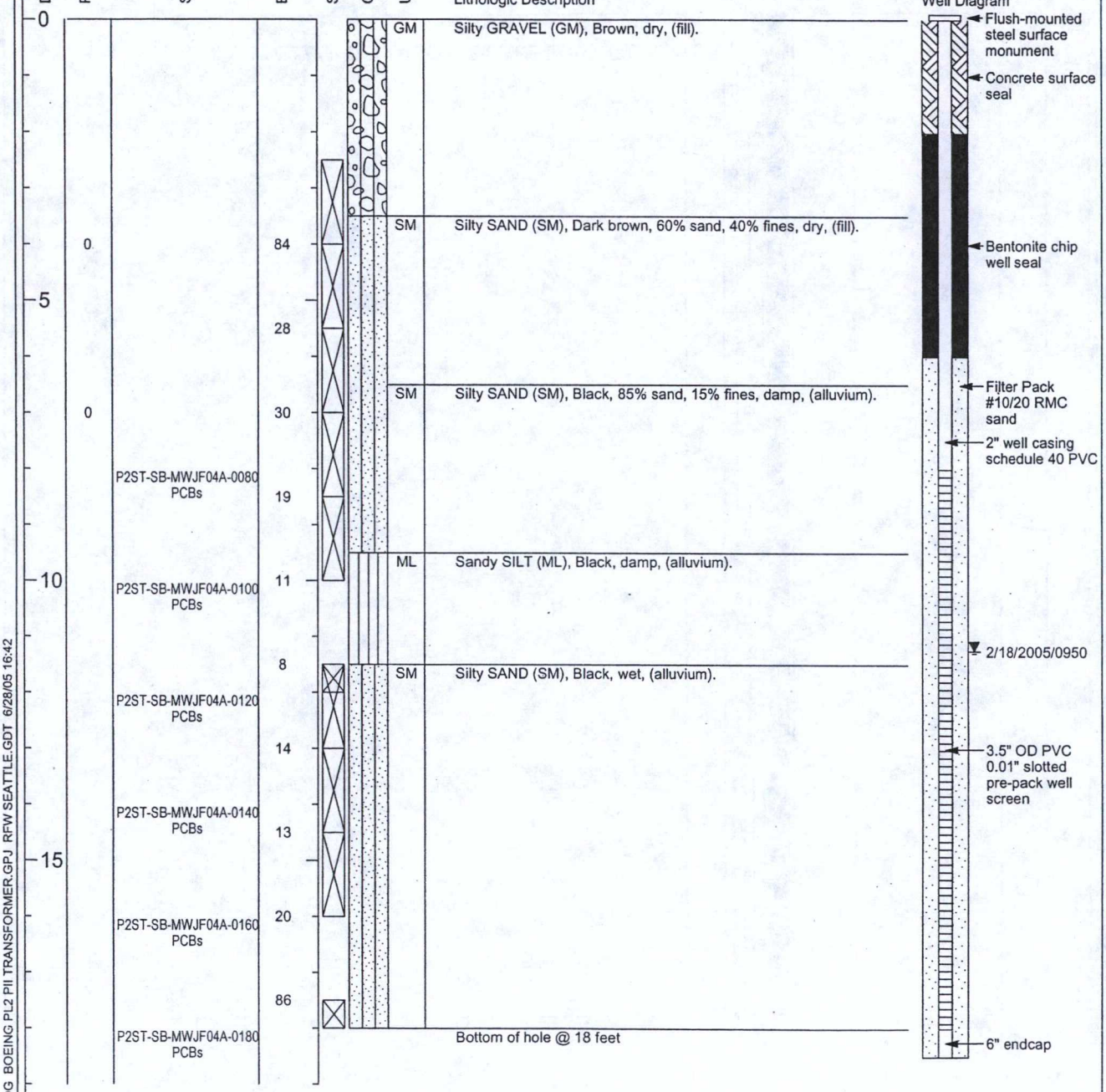
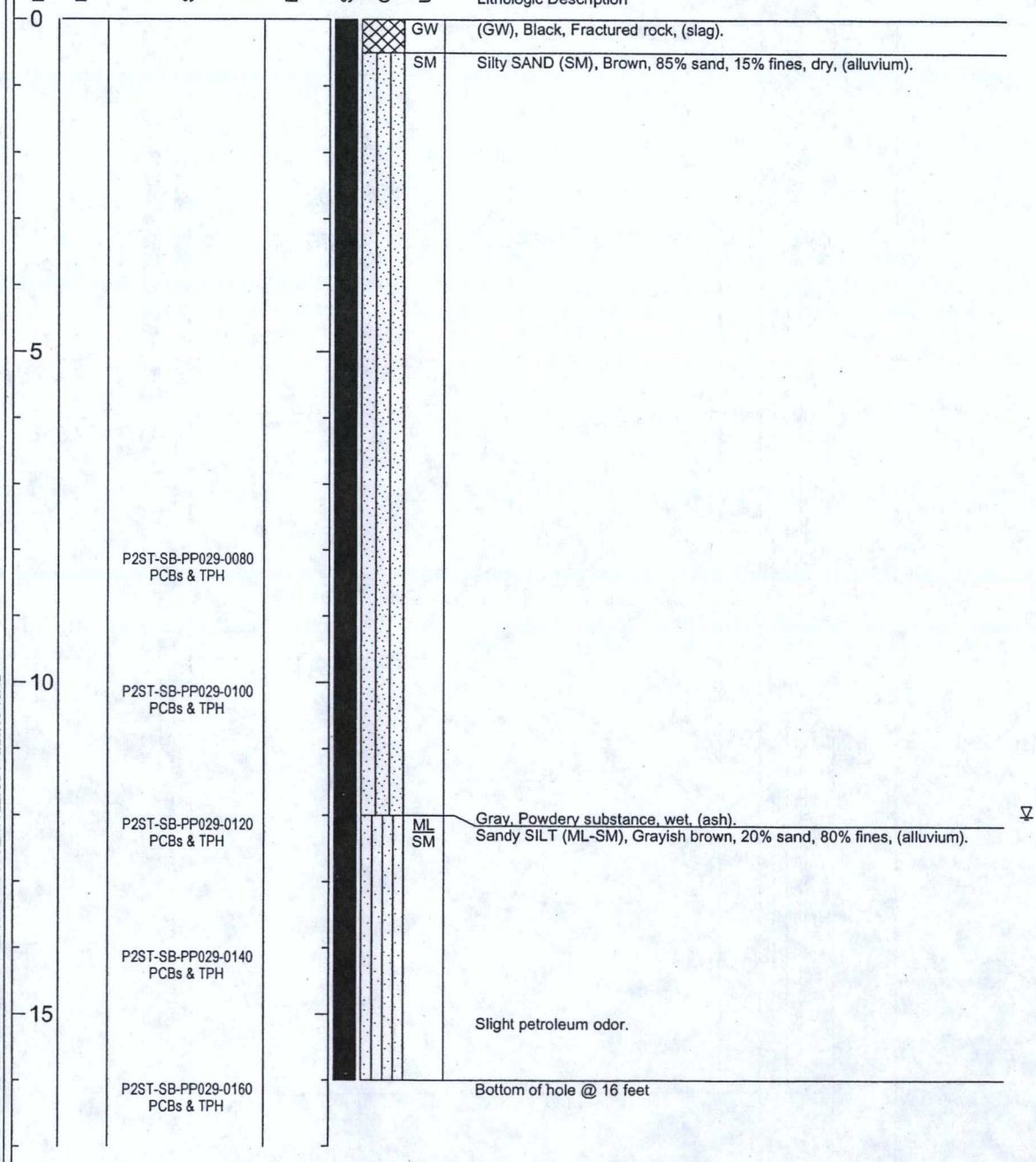


Plate
A-3

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

BORING LOG SB-07229r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.312 feet NGVD29
LOGGED BY K. Broom (Weston)



BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-4

BORING LOG SB-07230r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.277 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock, (slag).
						SM	Silty SAND (SM), Brown, 85% sand, 15% fines, dry, (alluvium).
5							Gray, 2-inch thick silty/clay laminae, (paleosol).
		P2ST-SB-PP030-0080 PCBs & TPH					
10		P2ST-SB-PP030-0100 PCBs & TPH				ML	Sandy SILT (ML), Grayish brown, 15% sand, 85% fines, slight petroleum odor, (alluvium).
		P2ST-SB-PP030-0120 PCBs & TPH					wet. ▽
		P2ST-SB-PP030-0140 PCBs & TPH					
15		P2ST-SB-PP030-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-5

BORING LOG SB-07231r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.655 feet NGVD29
LOGGED BY K. Broom (Weston)

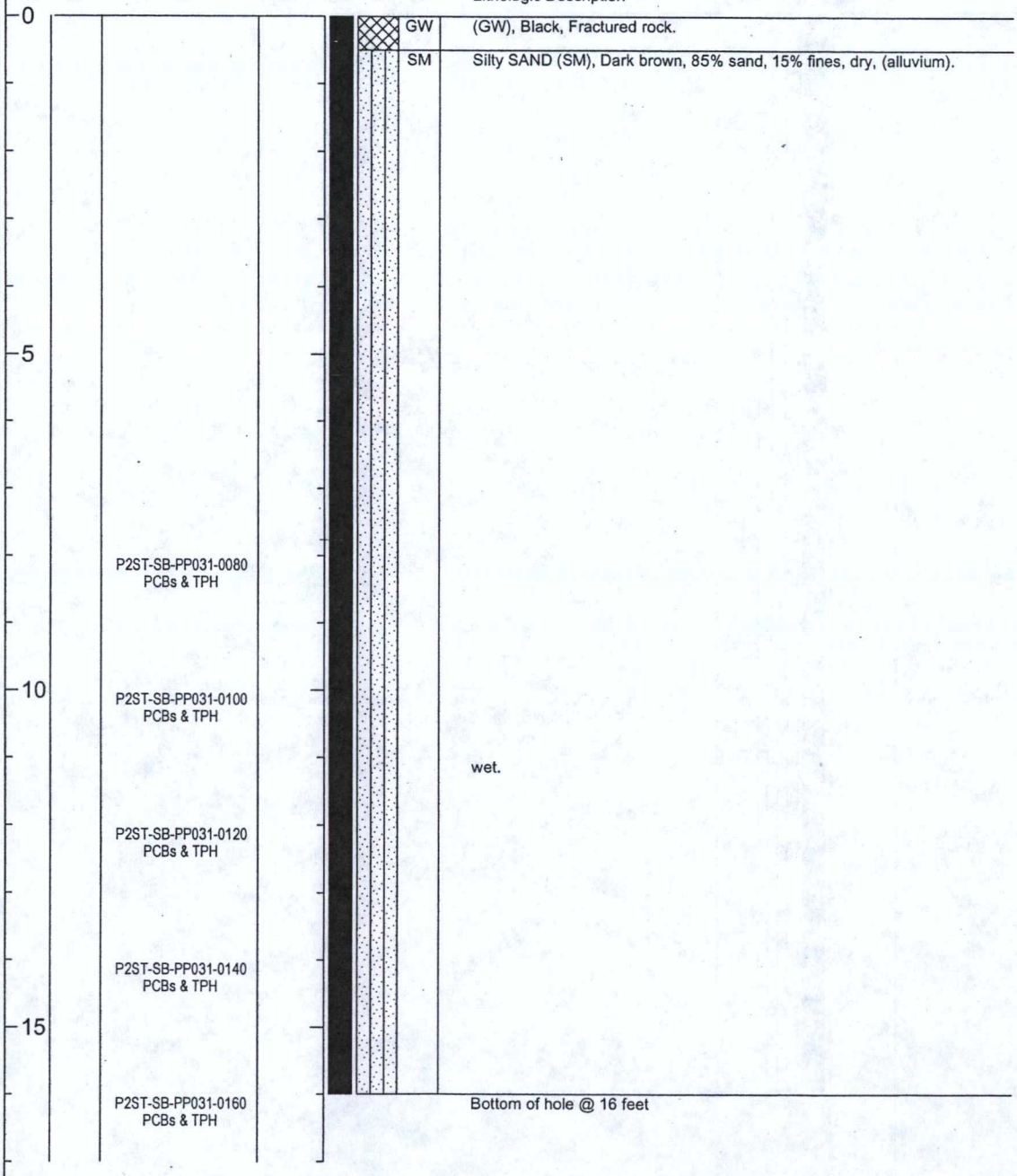


Plate
A-6

BORING LOG SB-07232r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.343 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	(GW), Black, Fractured rock.
						SM	Silty SAND (SM), Dark brown, 80% sand, 20% fines, dry, (alluvium).
5							
		P2ST-SB-PP032-0080 PCBs & TPH					
10		P2ST-SB-PP032-0100 PCBs & TPH					Gray, Fractured rock/soft material, dry, (ash).
						ML	Sandy SILT (ML), Gray, 15% sand, 85% fines, wet, petroleum odor, (alluvium).
		P2ST-SB-PP032-0120 PCBs & TPH					
		P2ST-SB-PP032-0140 PCBs & TPH					
15						SM	Silty SAND (SM), Black, 60% sand, 40% fines, wet, slight petroleum odor, (alluvium).
		P2ST-SB-PP032-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
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BORING LOG SB-07233r

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.349 feet NGVD29
LOGGED BY K. Broom (Weston)

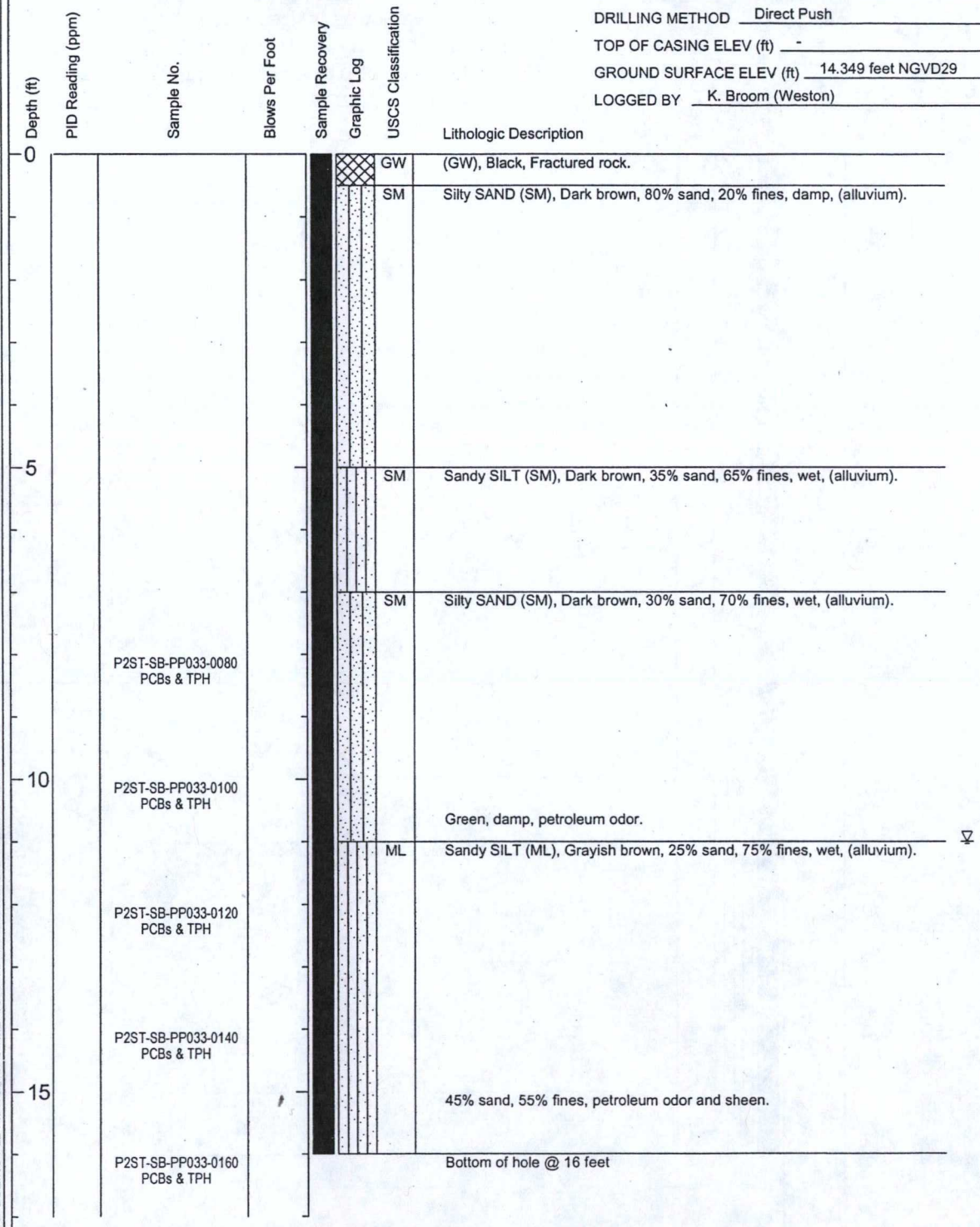

Plate
A-8

BORING LOG SB-07247a

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.469 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						SM	Silty SAND (SM), Dark brown, 80% sand, 20% fines, dry, (alluvium).
		P2ST-SB-PP047-0020 PCBs & TPH				ML	Sandy SILT (ML), Brown, 30% sand, 70% fines, dry, (alluvium).
		P2ST-SB-PP047-0040 PCBs & TPH					Dark brown, 20% sand, 80% fines, damp.
5		P2ST-SB-PP047-0060 PCBs & TPH				SM	Silty SAND (SM), Dark brown, 75% sand, 25% fines, damp, (alluvium).
10							Light gray.
						ML	Sandy SILT (ML), Light brown, 20% sand, 80% fines, damp, (alluvium).
						SM	Silty SAND (SM), Gray, 80% sand, 20% fines, wet, (alluvium). ▽
15							Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
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BORING LOG SB-07248

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.341 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Asphalt.
						ML	Sandy SILT (ML), Light brown, 40% sand, 60% fines, damp, (fill).
		P2ST-SB-PP048-0020 PCBs & TPH					
						SM	Silty SAND (SM), Dark brown, 80% sand, 20% fines, damp, (alluvium).
		P2ST-SB-PP048-0040 PCBs & TPH					
5							
		P2ST-SB-PP048-0060 PCBs & TPH					
						ML	SILT (ML), Dark brown, 15% sand, 85% fines, wet, (alluvium).
		P2ST-SB-PP048-0080 PCBs & TPH				SM	Silty SAND (SM), Dark brown, 75% sand, 25% fines, wet, (alluvium).
10		P2ST-SB-PP048-0100 PCBs & TPH				ML	Sandy SILT (ML), Dark brown to grayish, 15% sand, 85% fines, wet, (alluvium).
							Brown.
		P2ST-SB-PP048-0120 PCBs & TPH				SM	Silty SAND (SM), Dark brown, 75% sand, 25% fines, wet, (alluvium).
		P2ST-SB-PP048-0140 PCBs & TPH					
15							
		P2ST-SB-PP048-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
A-10

BORING LOG SB-07249

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.958 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Crushed rock.
						SM	Medium SAND (SM), Brown, 30% gravel, 70% sand, dry, (fill).
		P2ST-SB-PP049-0020 PCBs & TPH					
						CL ML	Silty CLAY (CL-ML), Brown, (paleosol).
						SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium).
		P2ST-SB-PP049-0040 PCBs & TPH					
5						SM	Fine SILT (SM), Grayish brown, 20% sand, 80% fines, damp, (alluvium).
		P2ST-SB-PP049-0060 PCBs & TPH					
		P2ST-SB-PP049-0080 PCBs & TPH					
10		P2ST-SB-PP049-0100 PCBs & TPH				ML	SILT (ML), Gray, 15% sand, 85% fines, wet, (alluvium). ▽
		P2ST-SB-PP049-0120 PCBs & TPH				SM	Silty SAND (SM), Redish brown, 70% sand, 30% fines, wet, (alluvium).
		P2ST-SB-PP049-0140 PCBs & TPH					
15						ML	Sandy SILT (ML), Grayish brown, 35% sand, 65% fines, wet, (alluvium).
		P2ST-SB-PP049-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
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BORING LOG SB-07250

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 13.993 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Crushed rock.
						SM	Medium SAND (SM), Brown, 30% gravel, 70% sand, dry, (fill).
		P2ST-SB-PP050-0020 PCBs & TPH					
						CL	Silty CLAY (CL-ML), Brown, (paleosol).
						ML/SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium).
		P2ST-SB-PP050-0040 PCBs & TPH					
5						SM	Fine SILT (SM), Grayish brown, 20% sand, 80% fines, damp, (alluvium).
		P2ST-SB-PP050-0060 PCBs & TPH					
		P2ST-SB-PP050-0080 PCBs & TPH					
10		P2ST-SB-PP050-0100 PCBs & TPH					▽
						ML	SILT (ML), Gray, 15% sand, 85% fines, wet, (alluvium).
		P2ST-SB-PP050-0120 PCBs & TPH					
						SM	Silty SAND (SM), Redish brown, 70% sand, 30% fines, wet, (alluvium).
		P2ST-SB-PP050-0140 PCBs & TPH					
15						ML	Sandy SILT (ML), Gray, 35% sand, 65% fines, wet, (alluvium).
		P2ST-SB-PP050-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-12

BORING LOG SB-07251

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.244 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						SW	Gravelly SAND (SW), Blackish brown, 40% gravel, 60% sand, dry, (fill).
						SM	Silty SAND (SM), Brown, 80% sand, 20% fines, dry, (fill).
						SM	Silty SAND (SM), Dark brown, dry, (alluvium).
5							
10						ML	Sandy SILT (ML), Grayish brown, 35% sand, 65% fines, damp, (alluvium).
						SM	Silty SAND (SM), Black, 70% sand, 30% fines, wet, (alluvium). ▽ 2/15/2005/0930
15							Bottom of hole @ 16 feet

Plate
A-13

BORING LOG SB-07252

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.235 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						SM	Gravelly SAND with SILT (SM), Black, 35% gravel, 60% sand, 5% fines, dry, (fill).
						SM	Silty SAND (SM), Brown, 75% sand, 25% fines, dry, (fill).
		P2ST-SB-PP052-0020 PCBs & TPH					
						ML	Sandy SILT (ML), Gray, 20% sand, 80% fines, damp, (alluvium).
		P2ST-SB-PP052-0040 PCBs & TPH					
5						SM	Silty SAND (SM), Dark brown, 75% sand, 25% fines, damp, (alluvium).
10						ML	Sandy SILT (ML), Gray, 15% sand, 85% fines, damp, (alluvium).
						SM	Silty SAND (SM), Dark brown, 70% sand, 30% fines, wet, (alluvium). ▽ 2/15/2005/0830
15							Bottom of hole @ 16 feet

Plate
A-14

BORING LOG SB-07253

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 14.315 feet NGVD29
LOGGED BY K. Broom (Weston)

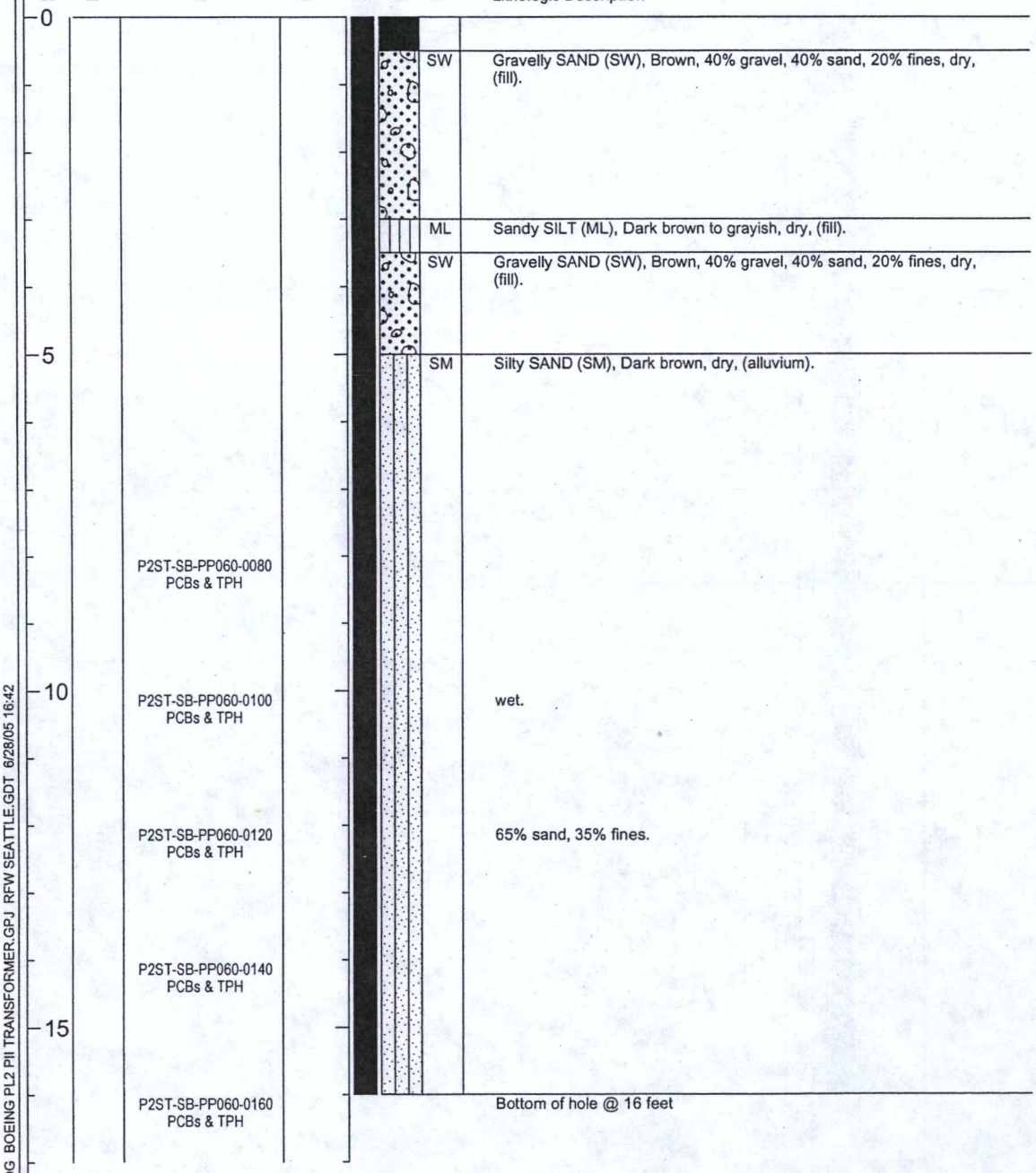
Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0						GW	Sandy GRAVEL (GW), Black, 65% gravel, 35% sand, dry, (fill).
						SM	Silty SAND (SM), Brown, 70% sand, 30% fines, dry, (fill).
		P2ST-SB-PP053-0020 PCBs & TPH					
		P2ST-SB-PP053-0040 PCBs & TPH				SM	Silty SAND (SM), Black, 75% sand, 25% fines, dry, (alluvium).
5							
		P2ST-SB-PP053-0060 PCBs & TPH					
						ML	SILT (ML), (alluvium).
						SM	Silty SAND (SM), Black, 75% sand, 25% fines, damp, (alluvium).
		P2ST-SB-PP053-0080 PCBs & TPH					
10		P2ST-SB-PP053-0100 PCBs & TPH					
		P2ST-SB-PP053-0120 PCBs & TPH					wet. ▽ 2/15/2005/1030
							grades to silt.
15							
							Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
A-15

BORING LOG SB-07560

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 15, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 12.972 feet NGVD29
LOGGED BY K. Broom (Weston)



Plate
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Weston Solutions, Inc. · 190 Queen Anne Avenue North, Suite 200 · Seattle, WA 98109

BORING LOG SB-07561

PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 12.527 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Asphalt.
						SM	Gravelly SAND with SILT (SM), Brownish red, 15% gravel, 75% sand, 15% fines, dry, (fill).
						SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium).
5							Dark brown, 75% sand, 25% fines.
		P2ST-SB-PP061-0080 PCBs & TPH					
10		P2ST-SB-PP061-0100 PCBs & TPH					
		P2ST-SB-PP061-0120 PCBs & TPH					wet. ▽
		P2ST-SB-PP061-0140 PCBs & TPH					
15		P2ST-SB-PP061-0160 PCBs & TPH					Bottom of hole @ 16 feet

BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

Plate
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BORING LOG SB-07562

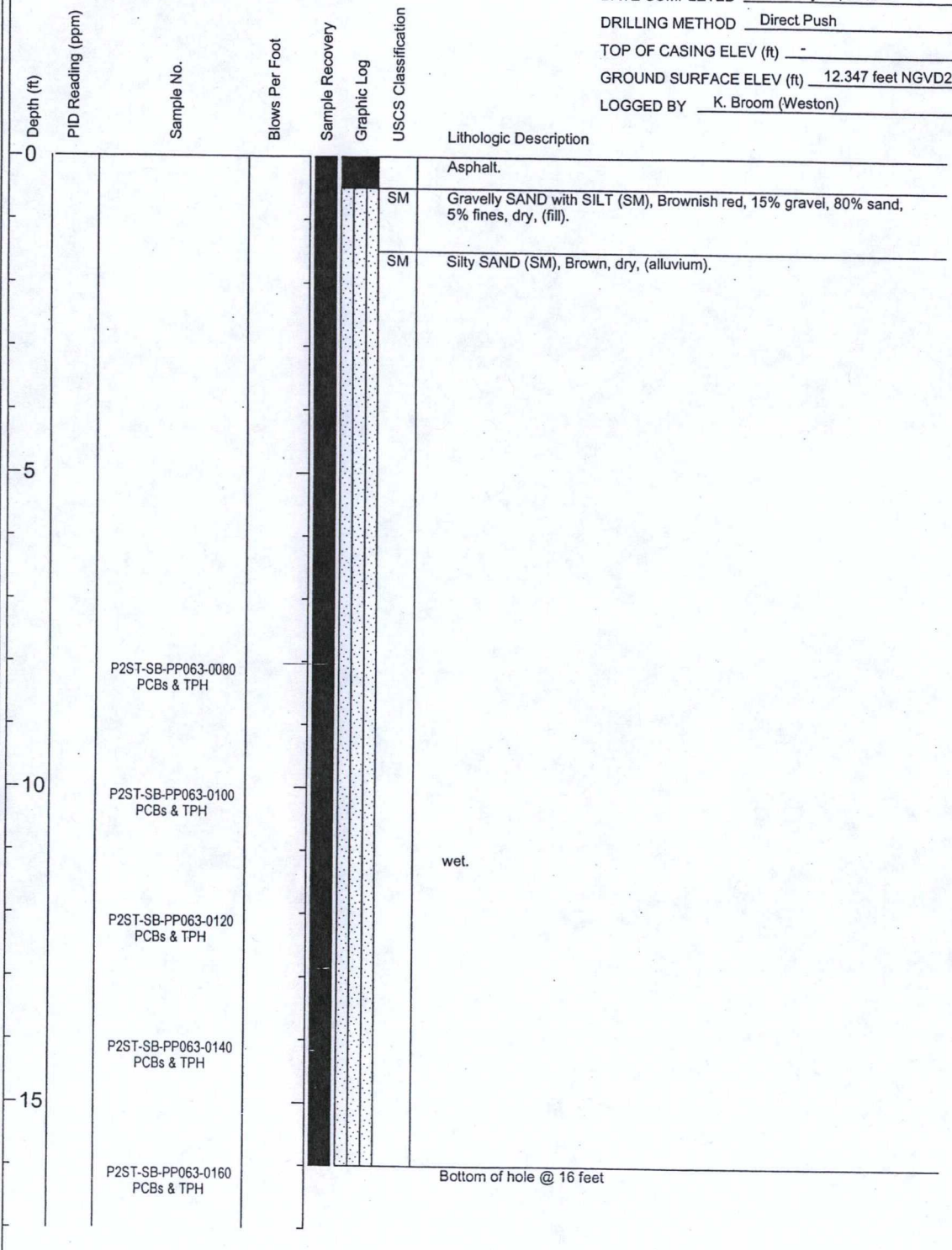
PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 12.684 feet NGVD29
LOGGED BY K. Broom (Weston)

Depth (ft)	PID Reading (ppm)	Sample No.	Blows Per Foot	Sample Recovery	Graphic Log	USCS Classification	Lithologic Description
0							Asphalt.
						SM	Medium SAND with GRAVEL (SM), Brown, 10% gravel, 85% sand, 5% fines, dry, (fill).
5						SM	Silty SAND (SM), Brown, 65% sand, 35% fines, dry, (alluvium). paleosol.
		P2ST-SB-PP062-0080 PCBs & TPH					
10		P2ST-SB-PP062-0100 PCBs & TPH					
		P2ST-SB-PP062-0120 PCBs & TPH					wet. ▽
		P2ST-SB-PP062-0140 PCBs & TPH					
15		P2ST-SB-PP062-0160 PCBs & TPH					Bottom of hole @ 16 feet

Plate
A-18

BORING LOG SB-07563

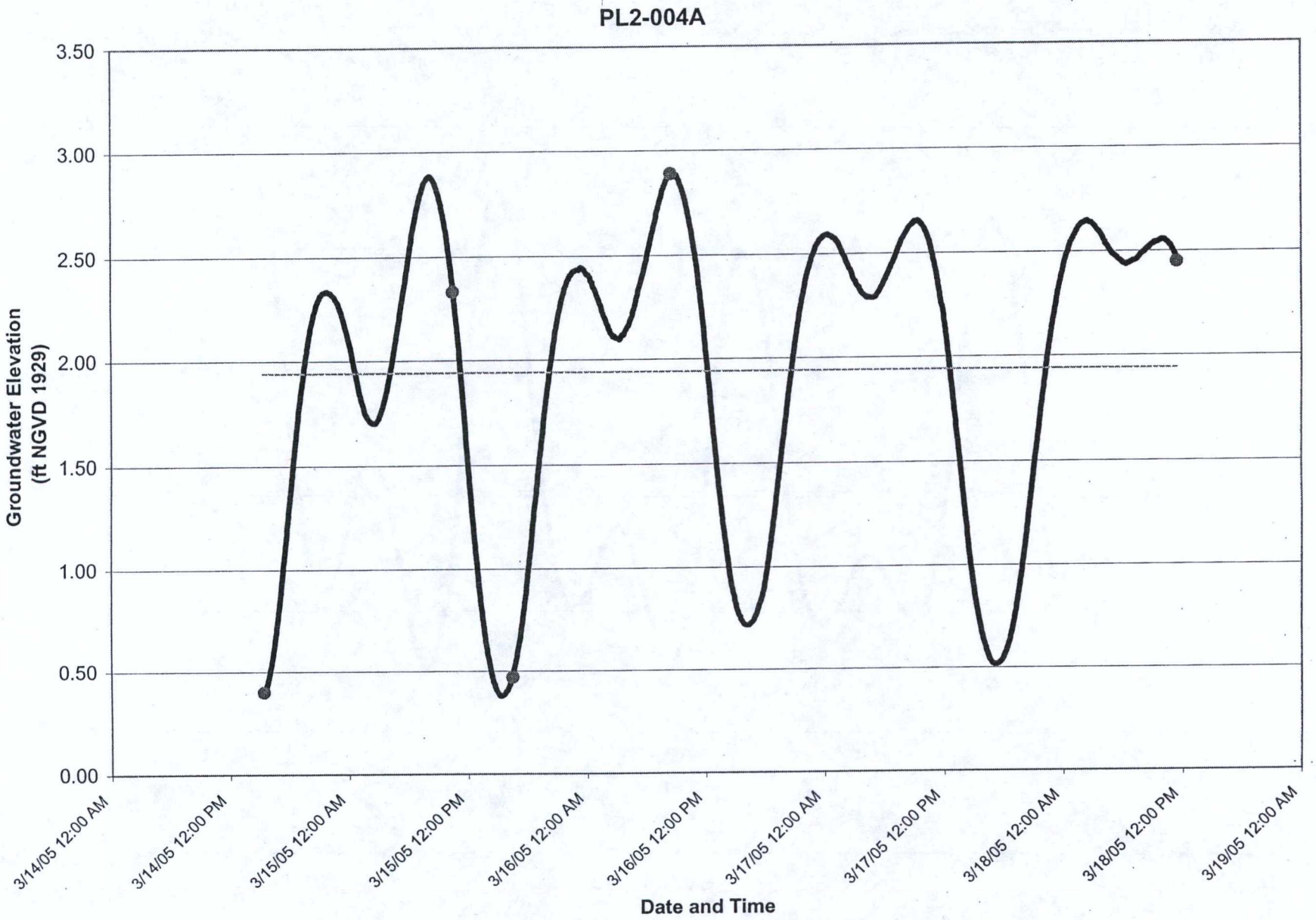
PROJECT Phase II PCB Transformer Investigation
JOB NUMBER 03709-079-001-0004
DATE COMPLETED February 14, 2005
DRILLING METHOD Direct Push
TOP OF CASING ELEV (ft) -
GROUND SURFACE ELEV (ft) 12.347 feet NGVD29
LOGGED BY K. Broom (Weston)

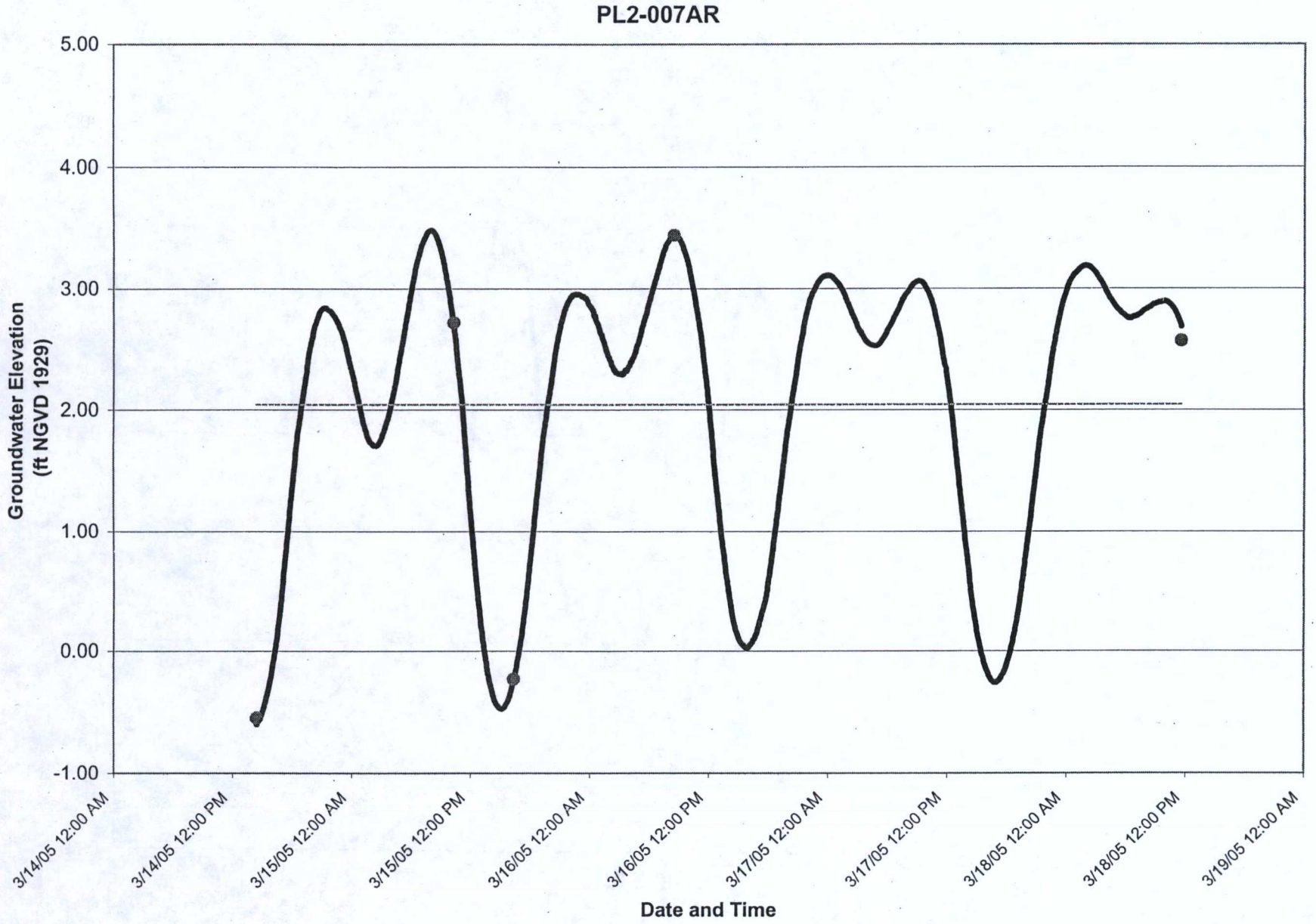


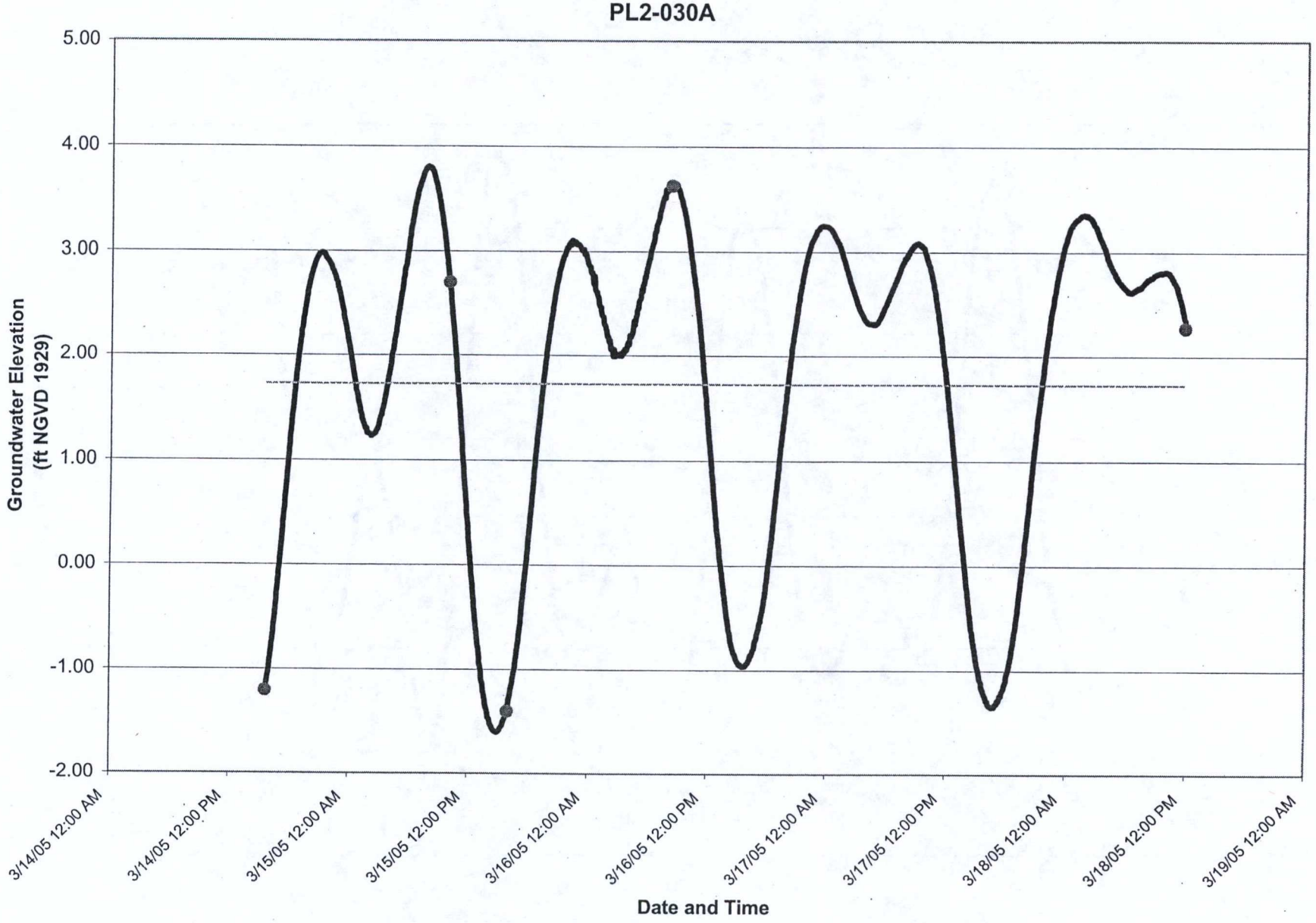
BOREHOLE LOG BOEING PL2 PII TRANSFORMER.GPJ RFW SEATTLE.GDT 6/28/05 16:42

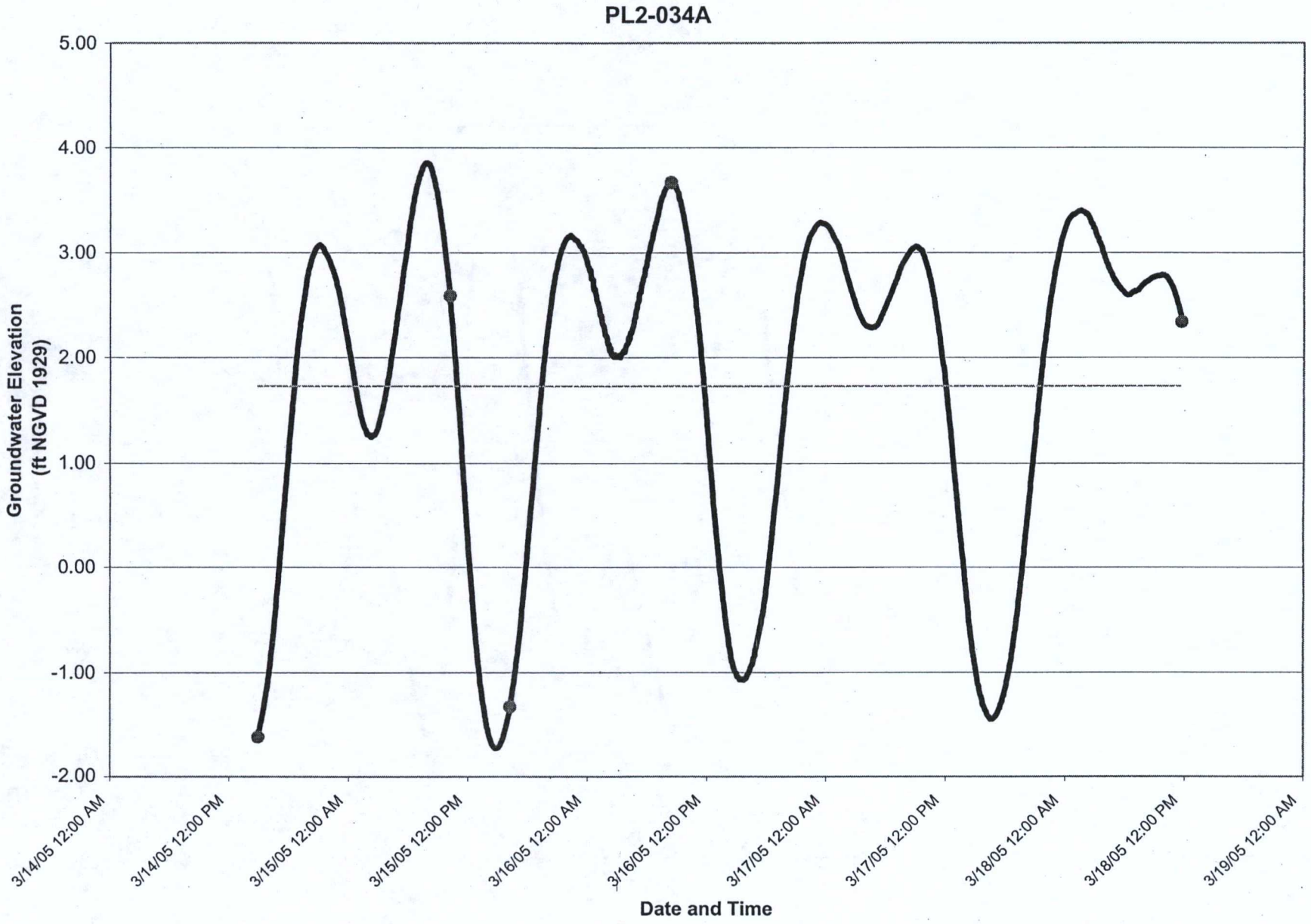
Plate
A-19

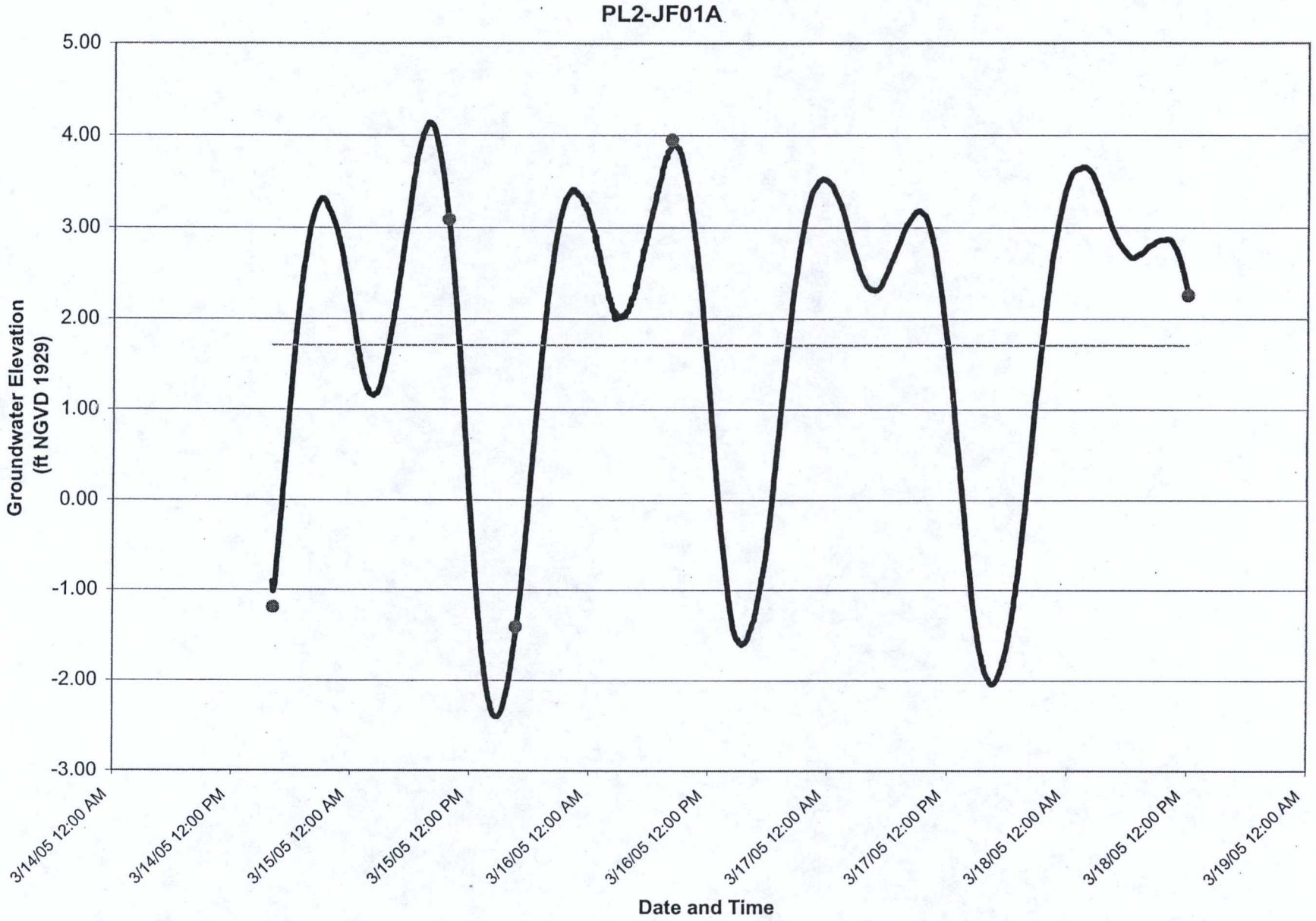
Transducer Study Charts


PL2-004A
Groundwater Elevation (ft NGVD 1929)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
3/14/05 12:00 AM
3/14/05 12:00 PM
3/15/05 12:00 AM
3/15/05 12:00 PM
3/16/05 12:00 AM
3/16/05 12:00 PM
3/17/05 12:00 AM
3/17/05 12:00 PM
3/18/05 12:00 AM
3/18/05 12:00 PM
3/19/05 12:00 AM
Date and Time


PL2-007AR
Groundwater Elevation (ft NGVD 1929)
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
3/14/05 12:00 AM
3/14/05 12:00 PM
3/15/05 12:00 AM
3/15/05 12:00 PM
3/16/05 12:00 AM
3/16/05 12:00 PM
3/17/05 12:00 AM
3/17/05 12:00 PM
3/18/05 12:00 AM
3/18/05 12:00 PM
3/19/05 12:00 AM
Date and Time


PL2-030A
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Groundwater Elevation (ft NGVD 1929)
3/14/05 12:00 AM
3/14/05 12:00 PM
3/15/05 12:00 AM
3/15/05 12:00 PM
3/16/05 12:00 AM
3/16/05 12:00 PM
3/17/05 12:00 AM
3/17/05 12:00 PM
3/18/05 12:00 AM
3/18/05 12:00 PM
3/19/05 12:00 AM
Date and Time


PL2-034A
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
Groundwater Elevation (ft NGVD 1929)
3/14/05 12:00 AM
3/14/05 12:00 PM
3/15/05 12:00 AM
3/15/05 12:00 PM
3/16/05 12:00 AM
3/16/05 12:00 PM
3/17/05 12:00 AM
3/17/05 12:00 PM
3/18/05 12:00 AM
3/18/05 12:00 PM
3/19/05 12:00 AM
Date and Time


PL2-JF01A
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
Groundwater Elevation (ft NGVD 1929)
3/14/05 12:00 AM
3/14/05 12:00 PM
3/15/05 12:00 AM
3/15/05 12:00 PM
3/16/05 12:00 AM
3/16/05 12:00 PM
3/17/05 12:00 AM
3/17/05 12:00 PM
3/18/05 12:00 AM
3/18/05 12:00 PM
3/19/05 12:00 AM
Date and Time

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report
Transducer Study Charts

Appendix B
Field Sampling Data Sheets

August 3, 2005

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2– 004A
Project Location: Boeing Plant 2
Sample No.: P2ST–GW-MW004A-0000
Project Number: 03709-079-001-0004
Sampler(s): K. Broom / R. Mason
Date/Time: 2/17/05
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
1235	☐ Meas. ☐ Hist.	9.65 Initial		

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☒ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 1238
Total Volume Purged: 3.0 gal
End Purge: Time: 1307
Well Volumes Purged:
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1310
Sample Collection Method: ☒ Pump Type: peri Dedicated ☒ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☒ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	1 L Amber	☒ Glass ☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass ☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass ☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/17/05 Well ID: PLZ-004A

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1238			15.11	1451	3.36	6.57	103.0	5.53
1242	10.15	0.25	15.29	1382	2.00	6.41	110.6	
1245		0.75	15.42	1366	1.59	6.41	102.6	4.73
1248		1.25	15.45	1363	1.24	6.43	93.2	5.29
1252		1.5	15.48	1361	1.04	6.44	89.4	6.81
1256		2.0	15.46	1363	0.95	6.44	88.4	
1300		2.5	15.44	1362	0.90	6.45	83.1	
1303		2.75	15.37	1362	0.87	6.45	83.8	6.53
1307		3.0	15.44	1361	0.86	6.46	79.9	6.35

Notes :

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2— 006AR
Project Location: Boeing Plant 2
Sample No.: P2ST— GW-MW006AR-0000
Project Number: 03709-079-001-0004
Sampler(s): K. Broom / R. Wilson
Date/Time: ~~12/16/05~~ 2/18/05
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
1245	☑ Meas. ☐ Hist.	9.42 Initial		

Water Level Measurement Method: ☑ Electric Tape ☐ Other:
Well Evacuation Method: ☑ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 1259 Total Volume Purged: 1.75 gal
End Purge: Time: 1311 Well Volumes Purged:
Purge Water Disposed: ☑ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☑ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1320
Sample Collection Method: ☑ Pump Type: peri Dedicated ☑ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☑ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	1 L Amber	☒ Glass ☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass ☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass ☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/18/05 Well ID: PLZ-006AR

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1250	9.70	0	14.23	1371	5.83	6.08	75.4	5.83
1253	9.84	0.25	14.51	1284	1.88	6.07	64.1	5.06
1256	9.86	0.50	14.59	1244	1.41	6.06	68.9	4.43
1259	9.92	0.75	14.60	1207	1.30	6.05	76.8	3.88
1302	9.92	1.0	14.65	1171	1.23	6.04	78.9	3.36
1305	9.93	1.25	14.69	1152	1.23	6.04	82.4	3.08
1308	9.93	1.5	14.70	1145	1.26	6.03	80.4	2.64
1311	9.91	1.75	14.68	1144	1.25	6.04	64.6	2.61

Notes :

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2-007AR
Project Location: Boeing Plant 2
Sample No.: P2ST-GW-MW007AR-0000
Project Number: 03709-079-001-0004
Sampler(s): K. Broom / R. Wilson
Date/Time: 2/18/05 0806
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
	☐ Meas. ☐ Hist.	Initial		

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☒ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 0800 Total Volume Purged: 5-8
End Purge: Time: 0851 Well Volumes Purged:
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 0900
Sample Collection Method: ☒ Pump Type: PERI Dedicated ☒ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☒ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type		Laboratory Analysis
2	1 L Amber	☒ Glass	☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass	☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass	☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/10/05 Well ID: PLZ-007AR

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
0800								
0835		3.5	15.34	2516	2.01	5.87	174.8	1.43
0838	10.06	4.1	15.29	2520	1.22	5.85	174.9	1.31
0841	10.05	4.5	15.14	2517	1.05	5.83	174.6	1.13
0844	10.05	4.8	15.18	2519	0.99	5.83	173.9	1.07
0847	10.04	5.1	15.21	2516	0.96	5.82	173.1	0.93
0851	10.05	5.5	15.28	2514	0.94	5.82	173.3	0.92

Notes :

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2— 030A
Project Location: Boeing Plant 2
Sample No.: P2ST— GW-MW030A-0000
Project Number: 03709-079-001-0004
Sampler(s): K Broom / R. Wilson
Date/Time: 2/17/05
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
1430	☐ Meas. ☐ Hist.	9.39 Initial		

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☒ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 1435 Total Volume Purged:
End Purge: Time: 1504 Well Volumes Purged:
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1510
Sample Collection Method: ☒ Pump Type: PERI Dedicated: ☒ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☒ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	1 L Amber	☒ Glass ☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass ☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass ☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/17/05 Well ID: PL2-030A

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1435		0.5	11.57	4968	1.38	6.64	111.7	0.75
1442		1.0	11.55	4855	0.88	6.65	112.2	
1455	10.09	2.25	11.55	4827	0.63	6.69	110.3	0.53
1458	10.14	2.75	11.52	4828	0.65	6.66	113.3	0.46
1501			11.56	4822	0.62	6.66	113.2	0.55
1504	10.18	3.0	11.55	4818	0.61	6.67	113.8	

Notes :

Turbidity = 0.23 at time of sampling.

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2- 034A
Project Location: Boeing Plant 2
Sample No.: P2ST-GW.MW034A.0000
Project Number: 03709-079-001-0004
Sampler(s): KB
Date/Time: 2/17/05
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
1025	☐ Meas. ☐ Hist.	9.31 Initial		

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☒ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 1030
Total Volume Purged: 3.0 gal
End Purge: Time: 1115
Well Volumes Purged:
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1120
Sample Collection Method: ☒ Pump Type: peri Dedicated ☐ Y ☒ N ☐ Bailer ☐ Other:
Decon Procedure: ☐ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type		Laboratory Analysis
2	0.5 ~~1~~ L Amber	☒ Glass	☐ Poly	PCBs as Aroclors/8082
~~1~~ 2	0.5 ~~1~~ L Amber	☒ Glass	☐ Poly	NWTPH-Dx
~~2~~ 1	0.25 L ~~40 mL~~ Amber	☒ Glass	☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/17/05 Well ID: PLZ-034A

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	±3% Cond (µS/cm)	±10% DO (mg/L)	±0.1 pH	ORP (mV)	Color/ Turbidity
1032	9.36	0	14.33	2689	4.35	6.79	41.8	57.2
1036	9.36	0.2	14.52	3157	2.55	6.58	7.9	18.9
1039	9.35	0.5	14.53	3390	1.69	6.55	6.7	10.8
1042	9.35	0.75	14.42	3429	1.45	6.54	5.2	10.44
1045	9.35	1.0	14.47	3441	1.33	6.50	4.2	8.73
1048		1.25	14.49	3461	1.20	6.50	4.1	8.88
1051		1.5	14.53	3474	1.04	6.49	4.4	5.88
1054		1.75	14.49	3486	1.00	6.49	6.2	4.56
1057		1.85	14.51	3479	0.92	6.49	9.0	6.28
1100		2.0	14.51	3479	0.91	6.48	9.4	5.71
1109		2.5	14.39	3476	0.83	6.47	14.4	4.09
1112		2.7	14.47	3467	0.83	6.47	15.8	3.06

Notes :

Turbidity = 3.51 at time of sampling

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2-- JFO1A
Project Location: Boeing Plant 2
Sample No.: P2ST-GW-MWJFO1A-0000 / -1000
Project Number: 03709-079-001-0004
Sampler(s): K. Broom / R. Wilson
Date/Time: 2/17/06
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
1610	18.85 ☑ Meas. ☐ Hist.	~~15.63~~ 14.69 KD Initial		

Water Level Measurement Method: ☑ Electric Tape ☐ Other:
Well Evacuation Method: ☑ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: 1620
Total Volume Purged: 2.75 gal
End Purge: Time: 1652
Well Volumes Purged:
Purge Water Disposed: ☑ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☑ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1655 (sample) 1705 (MS/MSD)
Sample Collection Method: ☑ Pump Type: perl Dedicated ☑ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☑ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type		Laboratory Analysis
2	1 L Amber	☒ Glass	☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass	☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass	☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	
		☐ Glass	☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: PC2-TP01A Well ID: 2/17/05

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
1625	14.87	—	14.75	924	2.67	6.55	118.6	
1630	14.94	0.5	15.03	930	1.51	6.54	22.0	
1643	15.11	2.0	15.09	940	0.91	6.52	4.9	3.55
1646	15.16	2.25	15.07	940	0.84	6.52	5.8	2.84
1649	15.21	2.5	15.06	939	0.81	6.52	6.3	
1652	15.27	2.75	15.06	938	0.81	6.52	10.0	

Notes :

Groundwater Sampling Record

Project Name: Phase II Transformer PCB Investigation: SCL Transformer
Well ID: PL2— JF04A
Project Location: Boeing Plant 2
Sample No.: P2ST— GW-MWJF04A-0000
Project Number: 03709-079-001-0004
Sampler(s): K. Broom / Ross Wilson
Date/Time: 2/10/05
Weather:

Water Level Measurements and Purge Data

Time	Depth of Well (TOC)	Depth to Water (TOC)	Feet of Water in Well	Gallons per Well Volume (2" dia. = 0.163 gal/ft, 4" dia.=0.653 gal/ft)
0950	☐ Meas. ☐ Hist.	11.25 Initial		

Water Level Measurement Method: ☒ Electric Tape ☐ Other:
Well Evacuation Method: ☒ Peristaltic Pump ☐ Submersible Pump ☐ Bailer ☐ Other:
Purge Rate:
Begin Purge: Time: ~~0945~~ 0955 (KB) Total Volume Purged:
End Purge: Time: Well Volumes Purged:
Purge Water Disposed: ☒ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Liquibin ☐ Other:

Sample Collection Method & Analysis

Sample Type: ☒ Groundwater ☐ Surface Water ☐ Other:
Sample Time: 1035
Sample Collection Method: ☒ Pump Type: peri Dedicated ☒ Y ☐ N ☐ Bailer ☐ Other:
Decon Procedure: ☒ N/A ☐ Liquinox Wash ☐ Tap Rinse ☐ DI Water ☐ Other:
Sample Description (color, turbidity, odor, sheen, etc.):

Sample Containers

Quantity	Size	Bottle Type	Laboratory Analysis
2	1 L Amber	☒ Glass ☐ Poly	PCBs as Aroclors/8082
1	1 L Amber	☒ Glass ☐ Poly	NWTPH-Dx
2	40 mL	☒ Glass ☐ Poly	TOC EPA SW846 9060m (H_3PO_4 to pH ≤ 2)
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	
		☐ Glass ☐ Poly	

Notes:

Sampler Signature: Kevin Broom

Date: 2/10/05 Well ID: PC2-JF04A

Well Evacuation / Field Parameters

Time	Depth to Water (TOC)	Volume (gallons)	Temp (°C)	Cond (µS/cm)	DO (mg/L)	pH	ORP (mV)	Color/ Turbidity
0956	11.53	0.25	13.57	567	2.98	6.30	85.1	
0959		0.5	13.86	830	2.00	6.27	71.5	
1014	11.50	2.0	14.15	492	1.13	6.24	58.6	7.13
1017		2.3	14.12	491	1.10	6.23	60.6	6.86
1023	11.49	2.9	14.01	488	1.04	6.23	63.1	5.26
1026		3.2	14.07	490	1.03	6.23	63.8	5.05
1029	11.47	3.5	13.99	491	1.01	6.23	65.5	4.89

Notes :

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Appendix C
Video Survey Documentation

August 3, 2005

1.0 Storm Pipe Survey

Three major storm pipe systems were surveyed either using a tractor mounted video camera or a steel snake/sonde setup. The video feed from the camera was recorded on a DVD. Selected photographs from the DVD are provided within this appendix. A description of video and sonde survey follows.

1.1 12-INCH BOEING STORM PIPE VIDEO SURVEY

The video survey for the Boeing 12-inch diameter concrete storm pipe extending eastward from SDMH 36-83 was conducted on February 16, 2005. The video camera was inserted into SDMH 36-83 and traversed in an eastward direction. The video segment on-screen time interval corresponding to the survey is 11:15 to 11:47. The camera was able to traverse 158 feet of the pipe before it was obstructed by soil and solids debris. The extent of the pipe included in the video survey is shown in brown on Figure 3.7. The video showed that the pipe is largely intact with no obvious break. An exception to this is at the 158-foot location where the camera was stopped; the grit within the pipe at this location appears to originate from a break in the pipe. Based on the survey, this 12-inch storm pipe was deemed to be inactive.

At a location 20 feet east of SDMH 36-83, a 6-inch pipe was observed connecting to the 12-inch pipe from the top. This connecting pipe was later determined to originate from the nearby stormwater vault. A second 6-inch pipe was observed connecting to the 12-inch pipe from the north side at a location 156 feet east of SDMH 36-83. This connecting pipe was observed to be plugged a short distance from the 12-inch pipe.

1.2 12-INCH PROPERTY LINE STORM PIPE VIDEO SURVEY

The video survey for the 12-inch diameter concrete storm pipe located on Jorgensen Forge property was conducted on May 2, 2005. The video camera was inserted into SDMH 15A and traversed westward towards the Duwamish Waterway. The video segment on-screen time interval corresponding to the survey is 14:13 to 14:40. The video camera was able to successfully traverse 240.6 feet of the pipe before it was stopped due to a large hole in the pipe bottom. The extent of the pipe included in the video survey is shown in green on Figure 2.1. The video shows that the pipe changes from concrete to CMP at approximately 191 feet. The pipe is largely intact with no obvious break (with the exception of the hole at 240.6 feet). Based on the survey, this 12-inch storm pipe was deemed to be inactive. This is supported by the presence of an approximately 12-inch thick layer of soil and slag in the bottom of SDMH 15A. The layer is thick enough to effectively plug both the inlet and outlet pipes.

1.3 24-INCH PROPERTY LINE STORM PIPE VIDEO SURVEY

The video survey for the 24-inch diameter concrete property line storm pipe located on the Jorgensen Forge was conducted on May 3, 2005. The video camera was inserted into SDMH 24A and traversed westward towards the Duwamish Waterway. The video segment on-screen time interval corresponding to the survey is 12:37 to 12:52. The video camera was able to successfully traverse 295.1 feet of the pipe before it was stopped due to the presence of a large

hole in the pipe bottom. At this point, the camera was underwater and below the level of the Duwamish Waterway. The extent of the pipe included in the video survey is shown in red on Figure 3.7. The video shows that the pipe changes from concrete to CMP at 241.1 feet and is largely intact with no obvious break (with the exception of the hole at 295.1 feet). No interconnecting pipe was observed downstream of SDMH 24A. However, 12 feet upstream of this manhole, a 12-inch diameter lateral concrete pipe was observed coming in from the south (on the Jorgensen Forge). The pipe was videotaped and found to the plugged with lumber at a distance of 10 feet from where it tied in to the 24-inch pipe[1].

Given that the video survey occurred during a dry weather period, the results of the survey are not conclusive regarding whether or not the 24-inch pipe is currently active (i.e., actively draining stormwater). Visual observations made inside the "Public" manhole near East Marginal Way indicate that this pipe is still active and accepts drainage from KCIA.

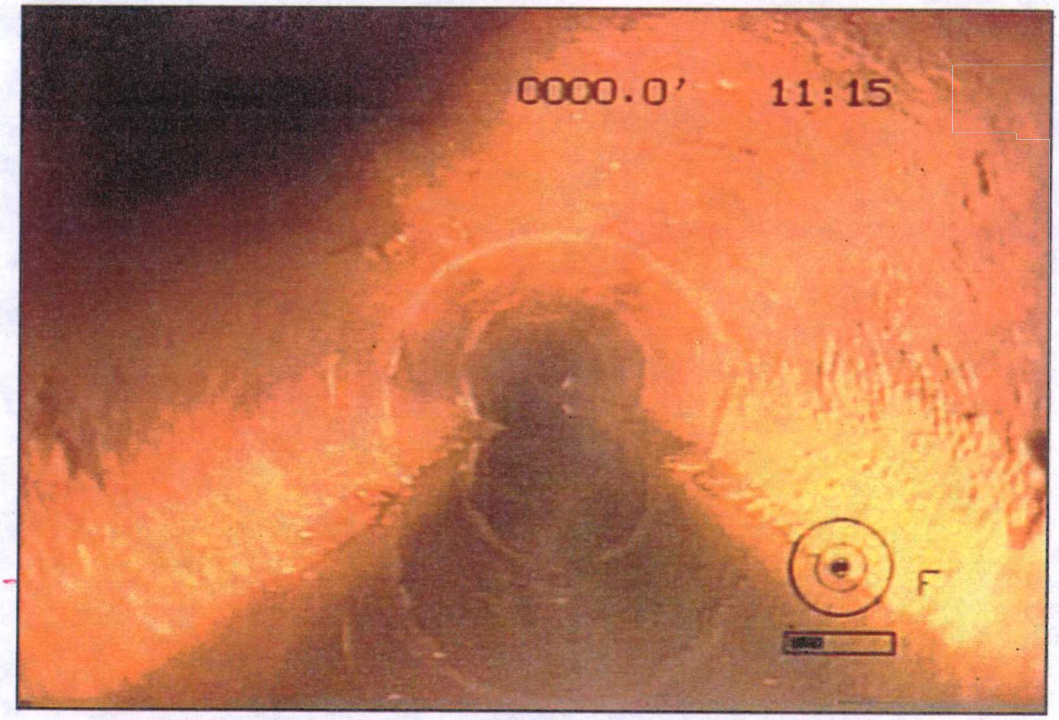
1.4 ADDITIONAL PIPE LOCATION SURVEYS

Location surveys for several additional storm pipes not included in the video surveys were performed on February 16, 2005. The pipes included in the location survey consist of all storm pipes connected to SDMH 36-83 that were unable to be surveyed by video and all storm pipes and catch basins located within the drainage area on at Plant 2 surrounding the former substation. The survey was conducted visually and by the insertion of a steel snake equipped with a sonde (a radio transmitter) with a camera scope into the pipes for their entire accessible length. The sonde device transmits radio signals that are picked up by a hand-held locating receiver. As the sonde was inserted into the pipes, the receiver was used to trace the path of the pipes, which were marked with paint on the ground surface. The pipe depths were measured and pipe construction materials were determined visually. The storm pipe features included in the survey are shown in brown on Figure 3.7.

Two 6-inch pipes observed within SDMH 36-83 were traced a short distance as shown in Figure 3.7. One pipe was a 6-inch cast iron pipe extending to the northwest from the manhole. The location survey was stopped while surveying this pipe because the pipe diameter changed from 6-inches to 4-inches. The sonde was obstructed by the lip of the smaller-diameter pipe. The second 6-inch pipe extends at least 14 feet southward towards the Jorgenson Forge and was observed to be caved in and plugged at the southern property boundary. These observations were made via a small video camera that was mounted on the sonde. A recording of the video was not made.

[1] SDMH 24A was previously unknown as it was gravel covered and only discovered in the field during the video survey activities.

photo 1



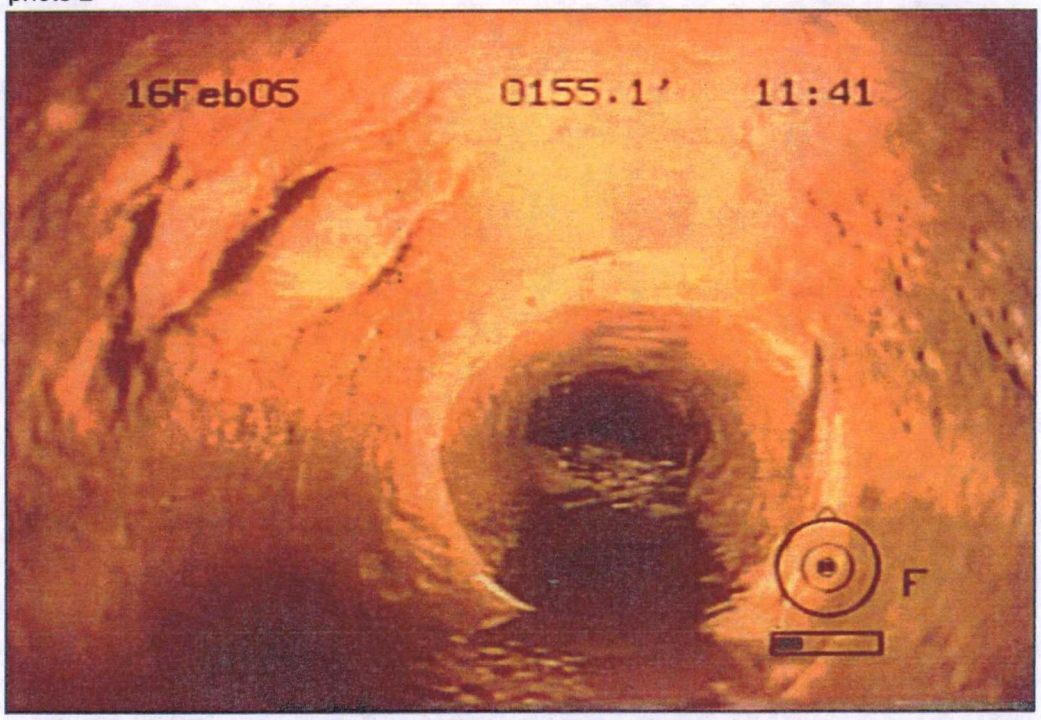
View from SDMH 36-83 facing east in 12-inch concrete Boeing storm pipe.

Photolog

WESTON SOLUTIONS

05-0098 Photolog.ai

photo 2



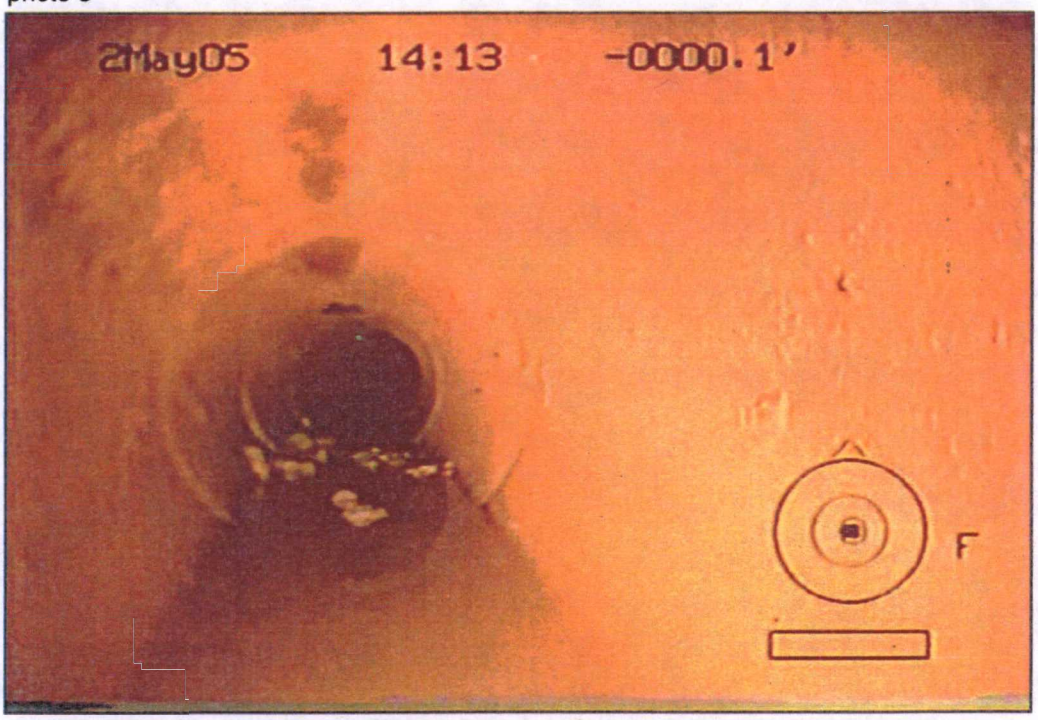
End of video survey on 12-inch concrete Boeing storm pipe due to debris in pipe, view facing east; also visible is a 6-inch lateral pipe connection.

Photolog

WESTON SOLUTIONS

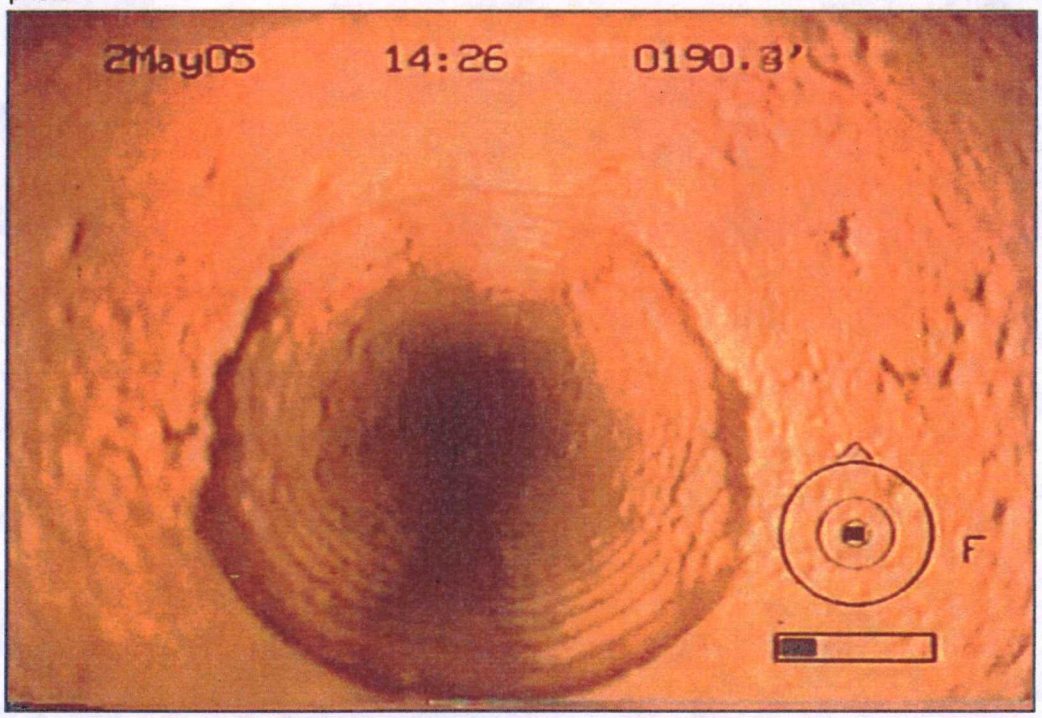
05-0098 Photolog.ai

photo 3



View from SDMH 15A facing west in 12-inch concrete Property Line storm pipe.

photo 4



View of 12-inch concrete Property Line storm pipe change to CMP; located 190.3 feet west of SDMH 15A.

Photolog

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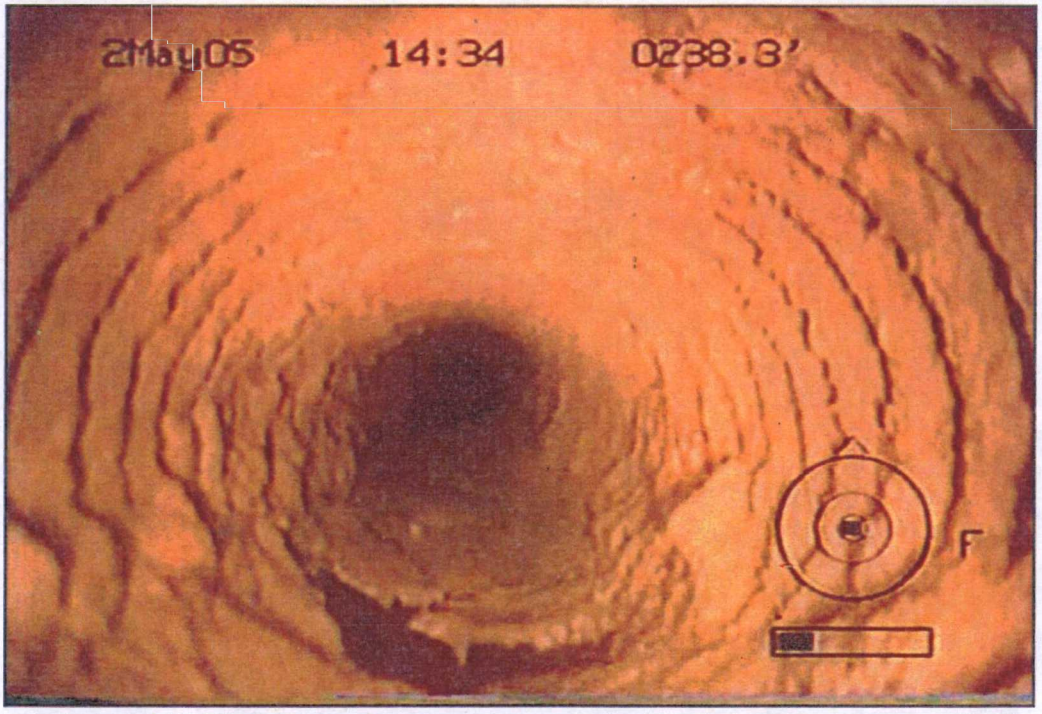
05-0098 Photolog.ai

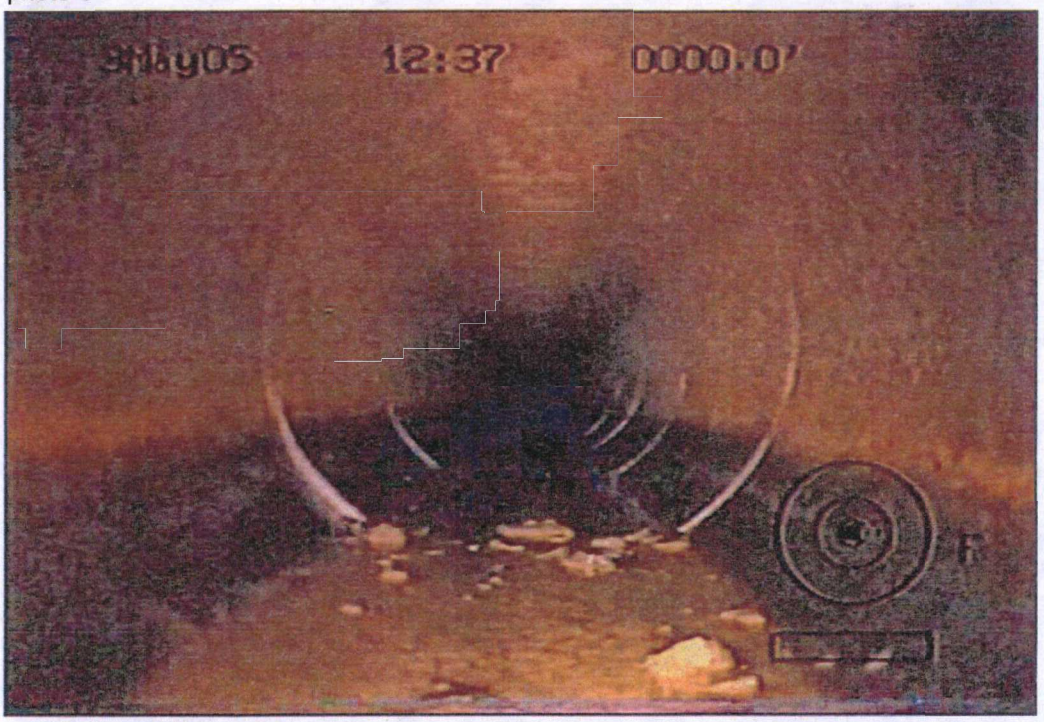
photo 5



End of video survey on 12-inch CMP Property Line storm pipe due to hole in pipe; located 238.3 feet west of SDMH 15A.

Photolog

photo 6



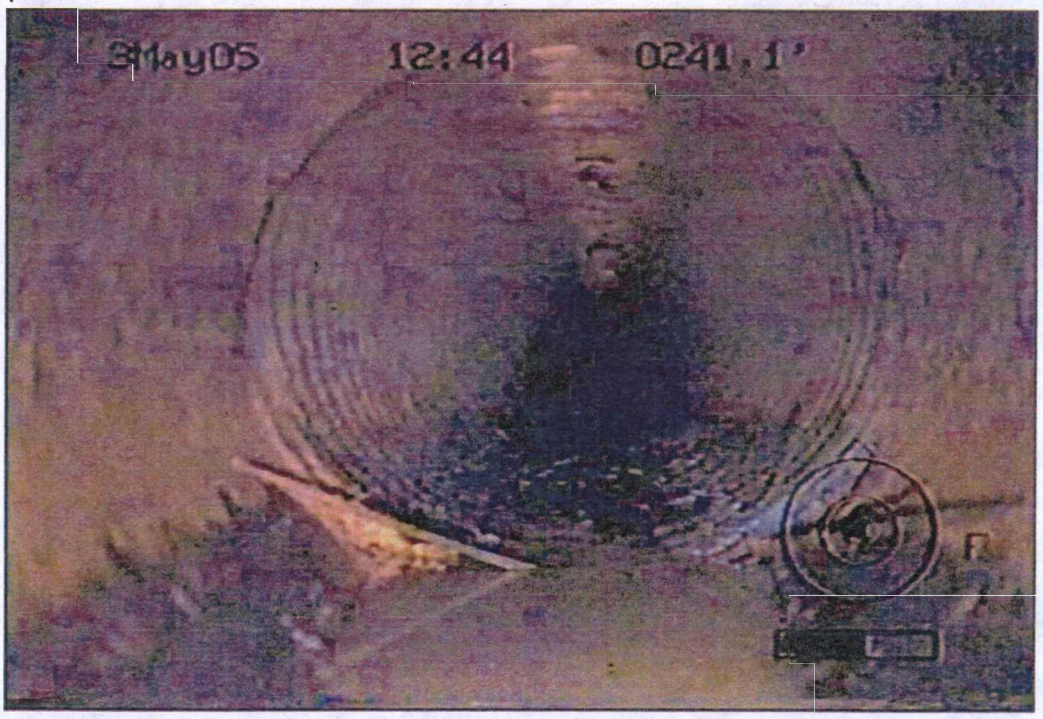
View from SDMH 24A facing west in 24-inch concrete Property Line storm pipe.

Photolog

WESTON SOLUTIONS

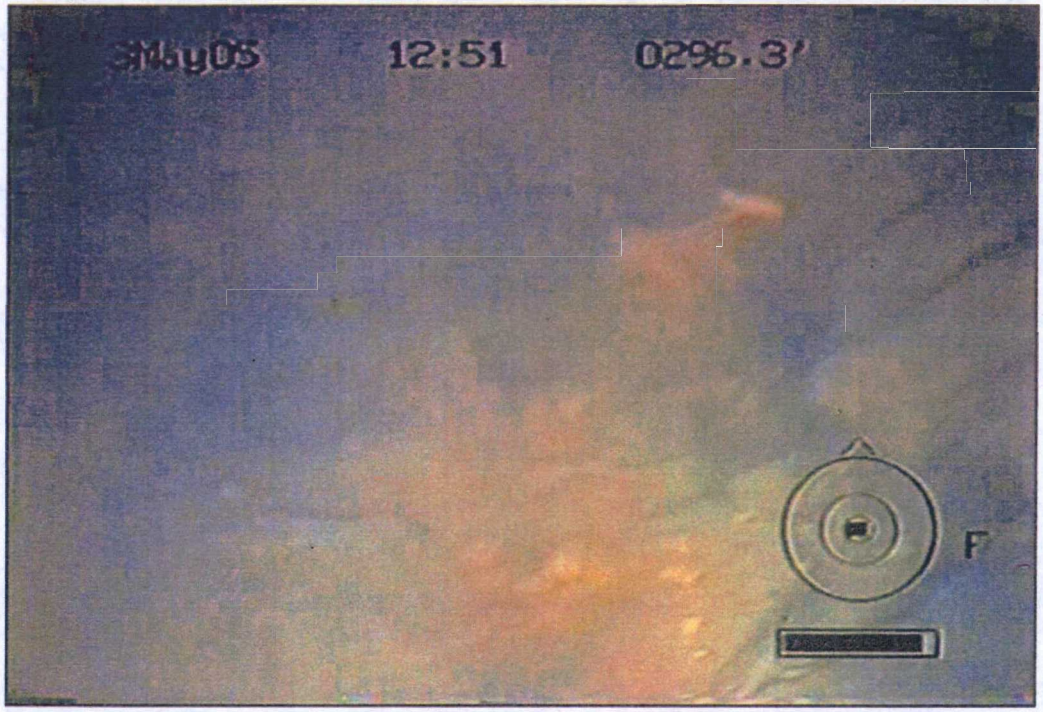
05-0098 Photolog.ai

photo 7



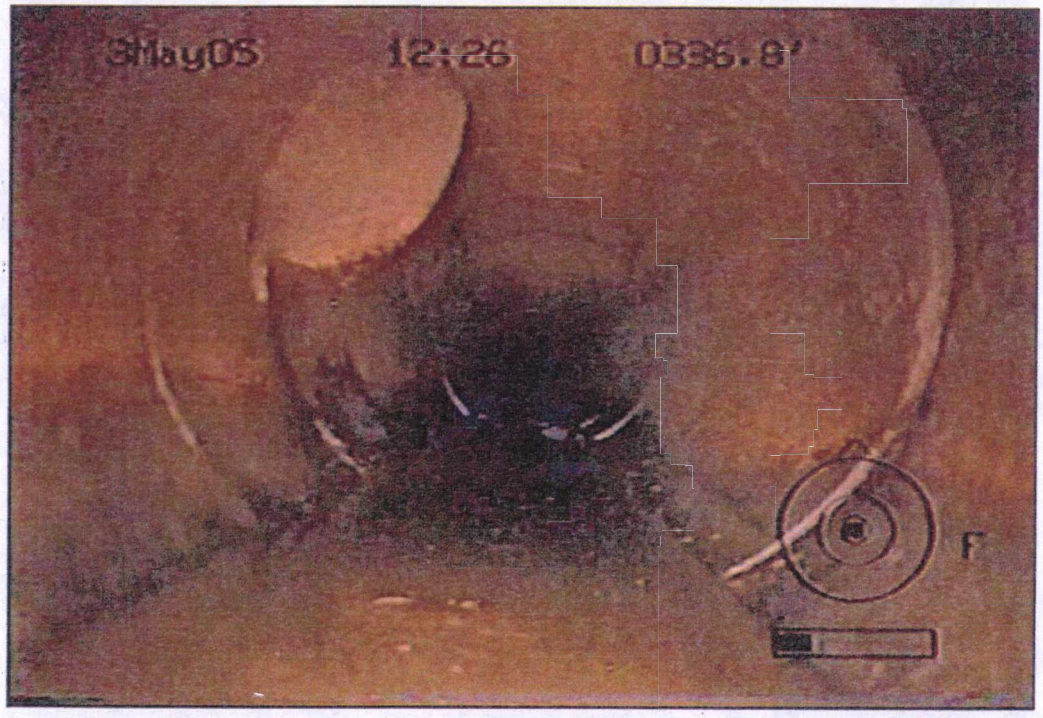
View of 24-inch concrete Property Line storm pipe change to CMP; located 241.1 feet west of SDMH 24A.

photo 8



End of video survey on 24-inch CMP Property Line storm pipe due to hole in pipe; located 296.3 feet west of SDMH 24A. Note: the tractor mounted video camera was underwater at time of survey.

photo 9



View of 12-inch lateral pipe from Jorgensen connecting with 24-inch Property Line storm pipe, view facing west. SDMH 24A is also visible in this image.

Photolog

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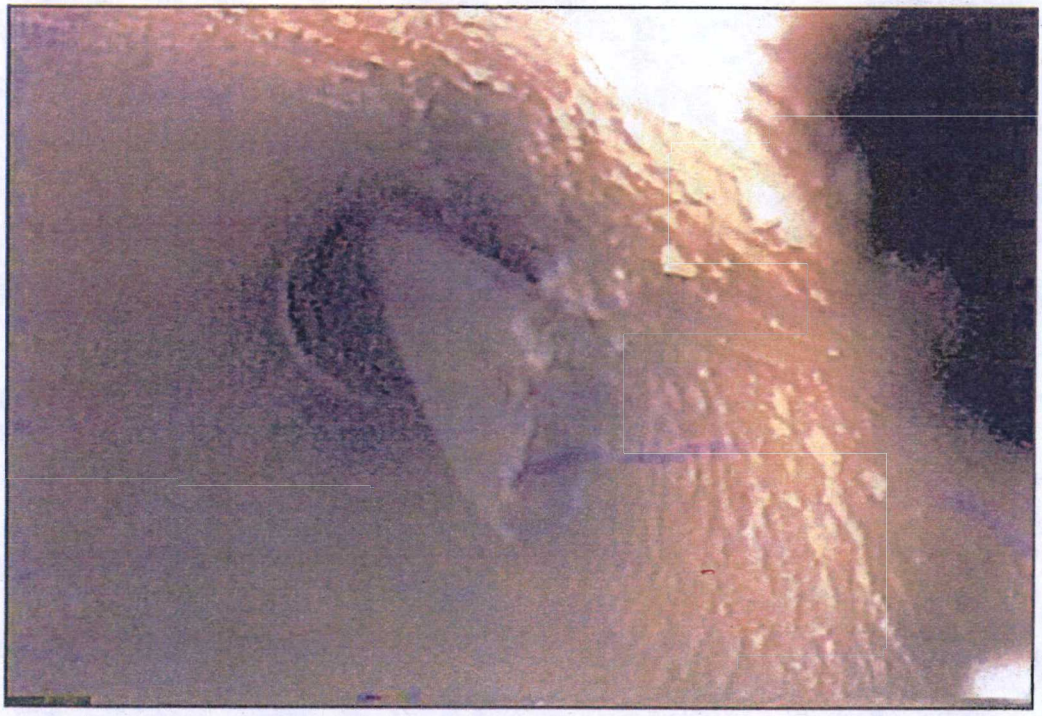
05-0098 Photolog.ai

photo 10



View of dimensional lumber obstruction in the 12-inch storm pipe from Jorgensen connecting with the 24-inch Property Line storm pipe.

Photolog

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Boeing Plant 2
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Appendix D
TPH Chromatograms

August 3, 2005

Soil Samples

Total TPH > 200 mg/kg

Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
PL2-006AR	P2ST-SB-MW006AR-0080	Soil	6	8	350		1,500		2,700	J	4,550	J

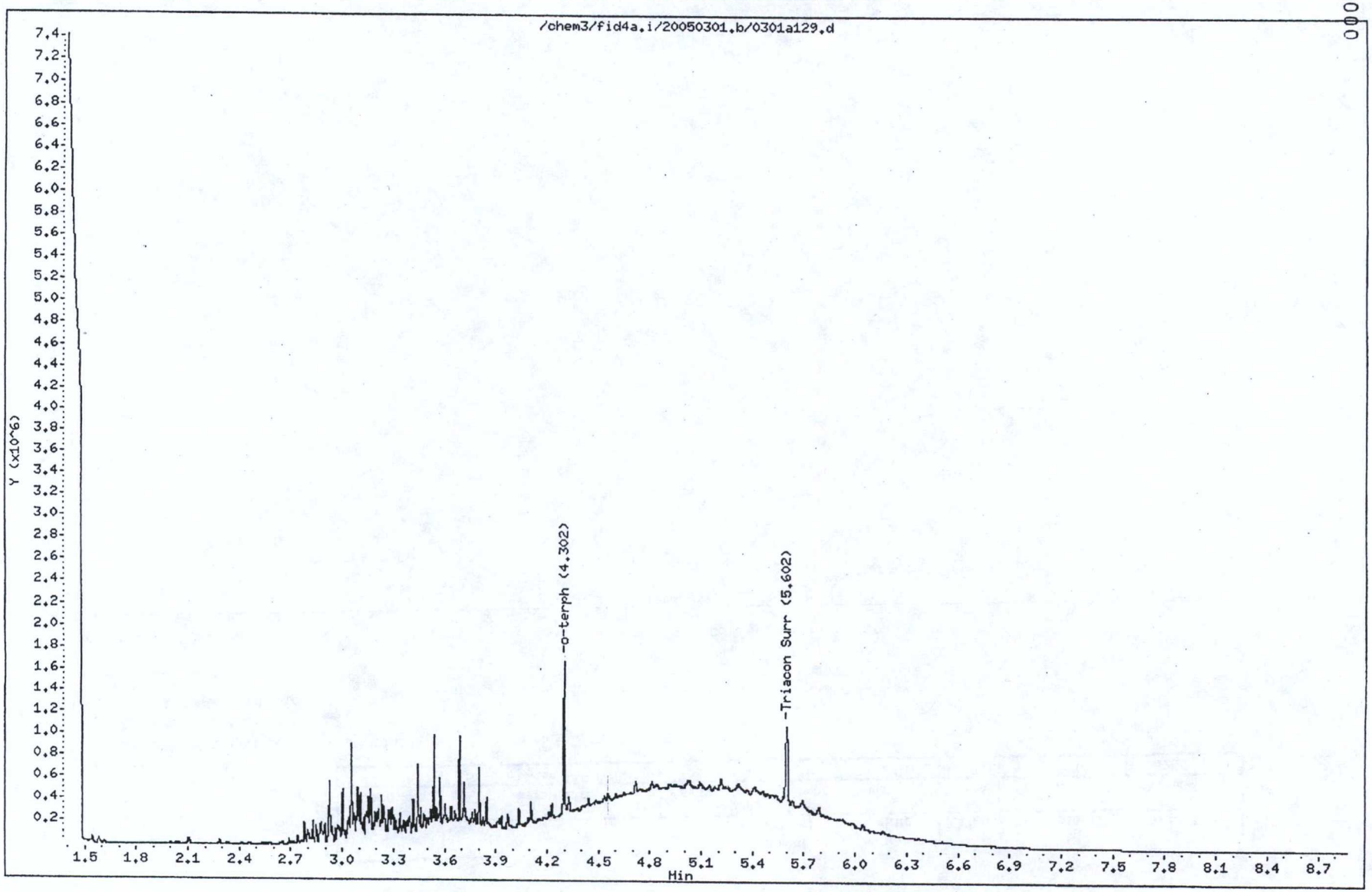
Data File: /chem3/fid4a.i/20050301.b/0301a129.d
Date : 02-MAR-2005 21:50
Client ID: P2ST-SB-MW006AR-008
Sample Info: HS86G

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

000279



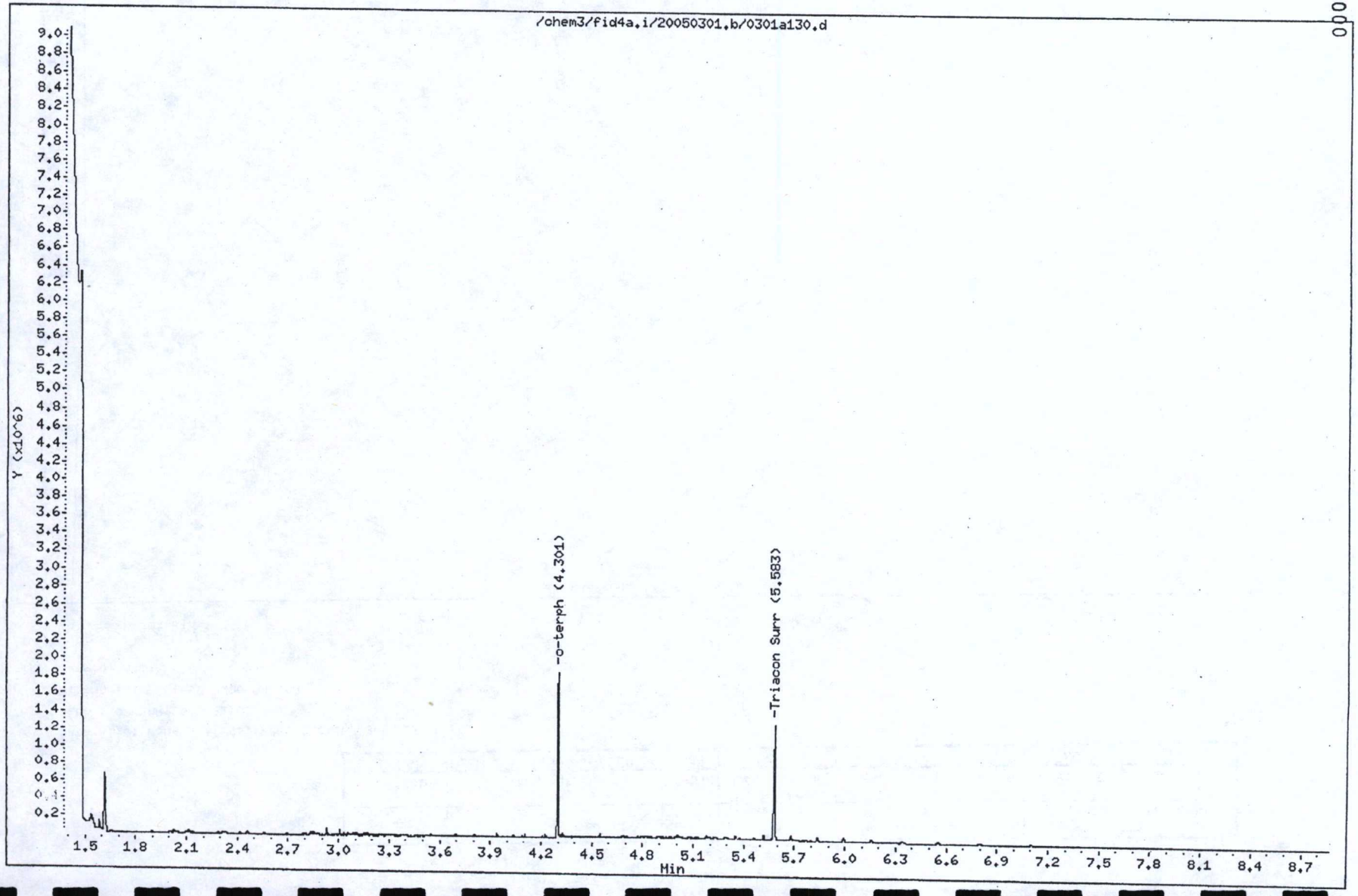
Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
PL2-006AR	P2ST-SB-MW006AR-0100	Soil	8	10	34	U	100		220	J	320	J

Data File: /chem3/fid4a.i/20050301.b/0301a130.d
Date : 02-MAR-2005 22:06
Client ID: P2ST-SB-MW006AR-010
Sample Info: HS86H

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
PL2-006AR	P2ST-SB-MW006AR-0120	Soil	10	12	4,100		8,400		14,000	J	26,500	J

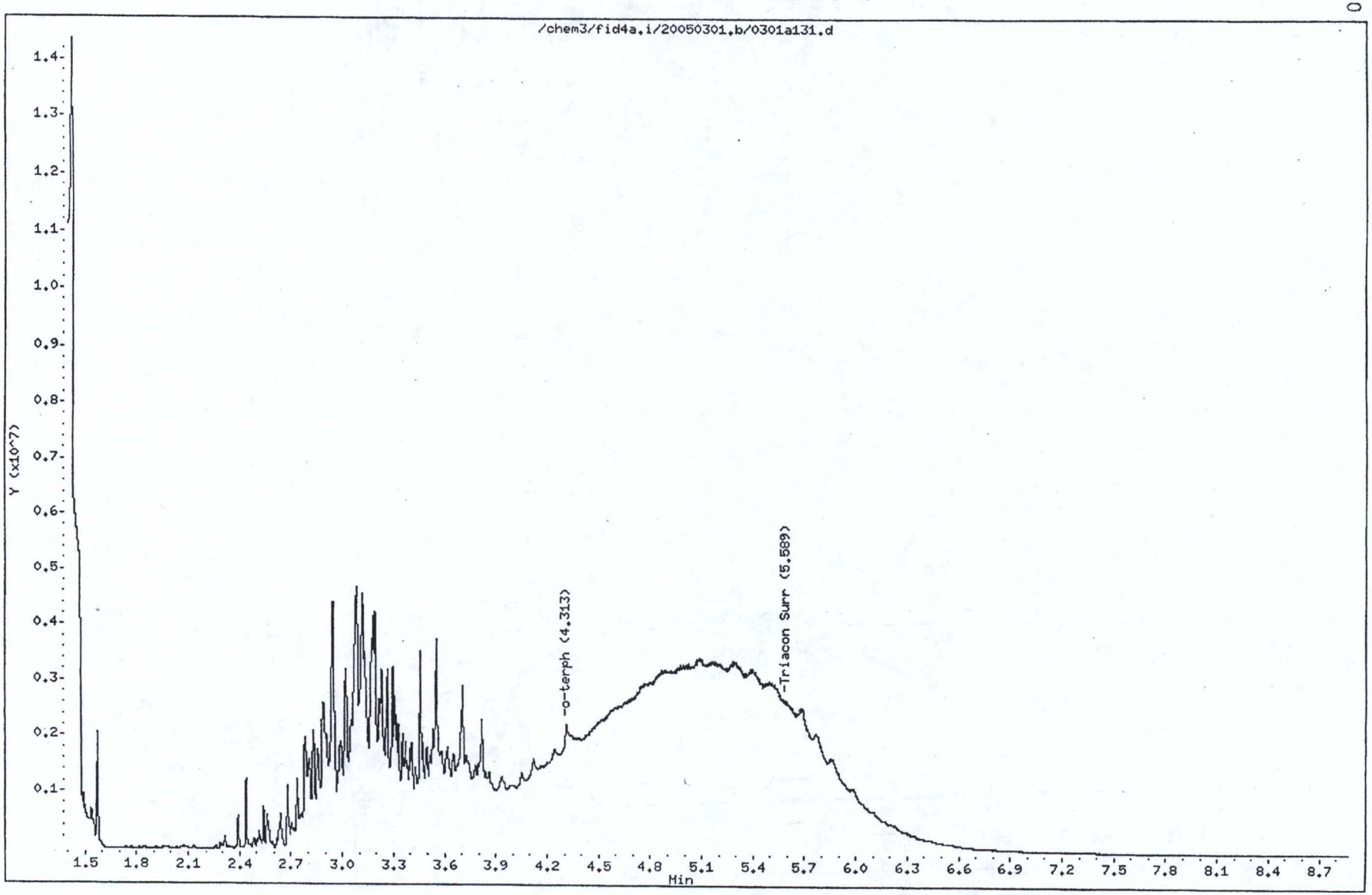
Data File: /chem3/fid4a.i/20050301.b/0301a131.d
Date : 02-MAR-2005 22:21
Client ID: P2ST-SB-MW006AR-012
Sample Info: HS86I

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

000283



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
PL2-006AR	P2ST-SB-MW006AR-0140	Soil	12	14	4,200		9,400		16,000	J	29,600	J

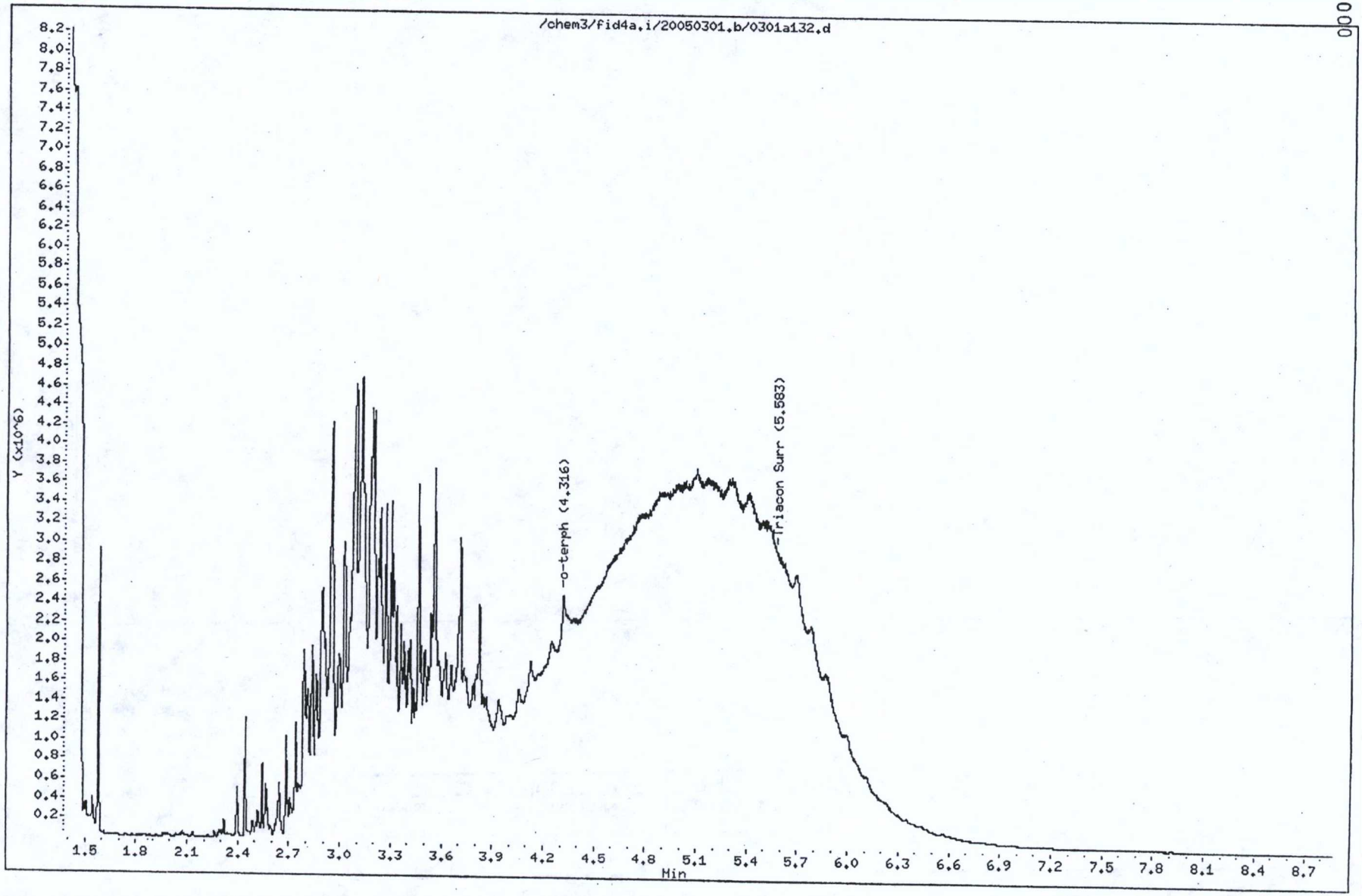
Data File: /chem3/fid4a.i/20050301.b/0301a132.d
Date : 02-MAR-2005 22:37
Client ID: P2ST-SB-MW006AR-014
Sample Info: HS86J

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

000287



Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
PL2-006AR	P2ST-SB-MW006AR-0160	Soil	14	16	120		950		1,600	J	2,670	J

Data File: /chem3/fid4a.i/20050301.b/0301a133.d

Date : 02-MAR-2005 22:53

Client ID: P2ST-SB-MW006AR-016

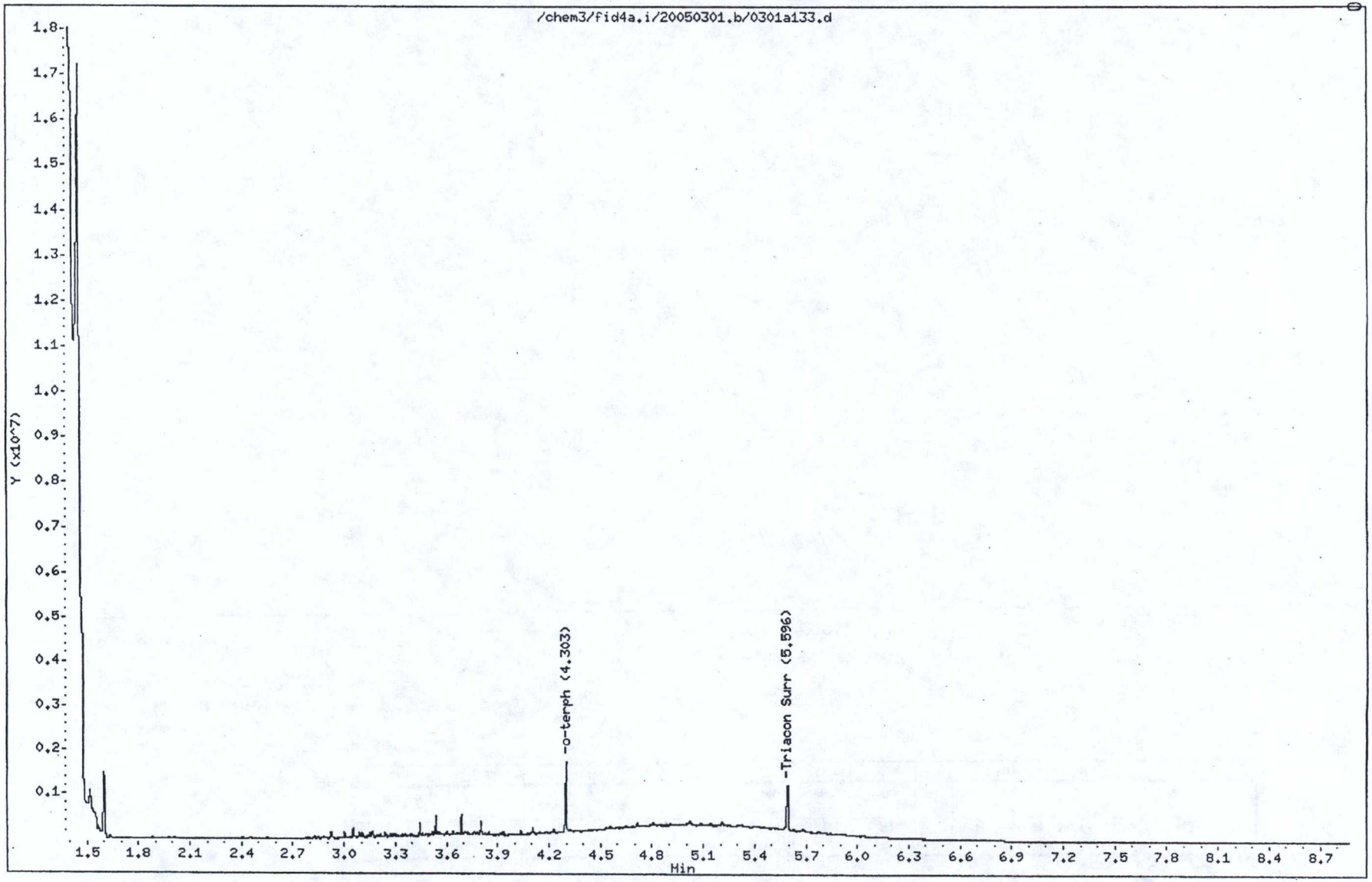
Instrument: fid4a.i

Sample Info: HS86K

Operator: PC

Column phase: RTX-1

Column diameter: 2.00



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
PL2-JF04A	P2ST-SB-MWJF04A-0120	Soil	10	12	33	U	140		390	J	530	J

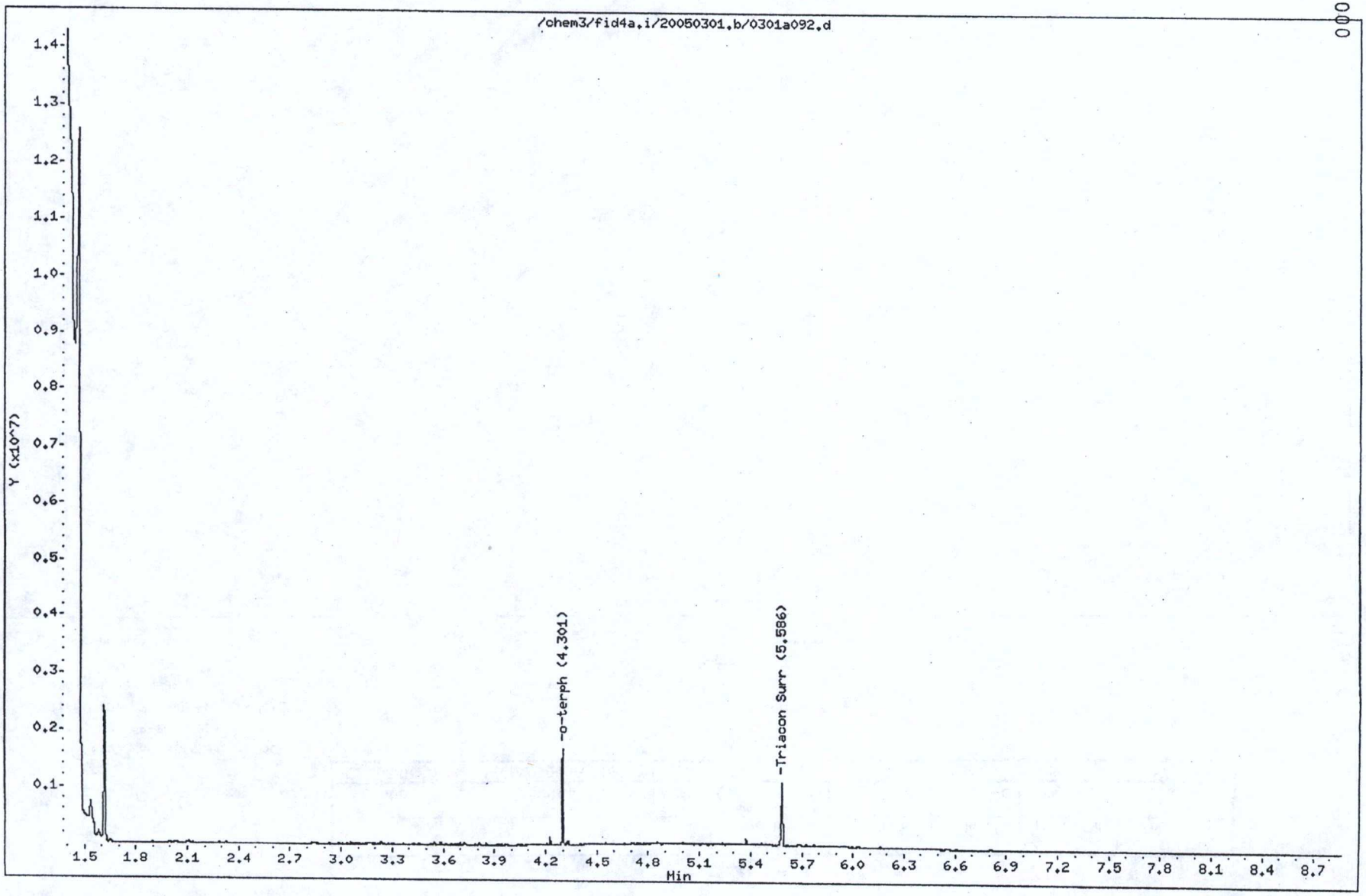
Data File: /chem3/fid4a.i/20050301.b/0301a092.d
Date : 02-MAR-2005 11:48
Client ID: P2ST-SB-MWJF04A-012
Sample Info: HS85C

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

000181



Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
SB-07229r	P2ST-SB-PP029-0080	Soil	6	8	75		130		260	J	**465**	J

Data File: /chem3/fid4a.i/20050301.b/0301a074.d

Page 1

Date : 02-MAR-2005 06:58

Client ID: P2ST-SB-PP029-0080

Instrument: fid4a.i

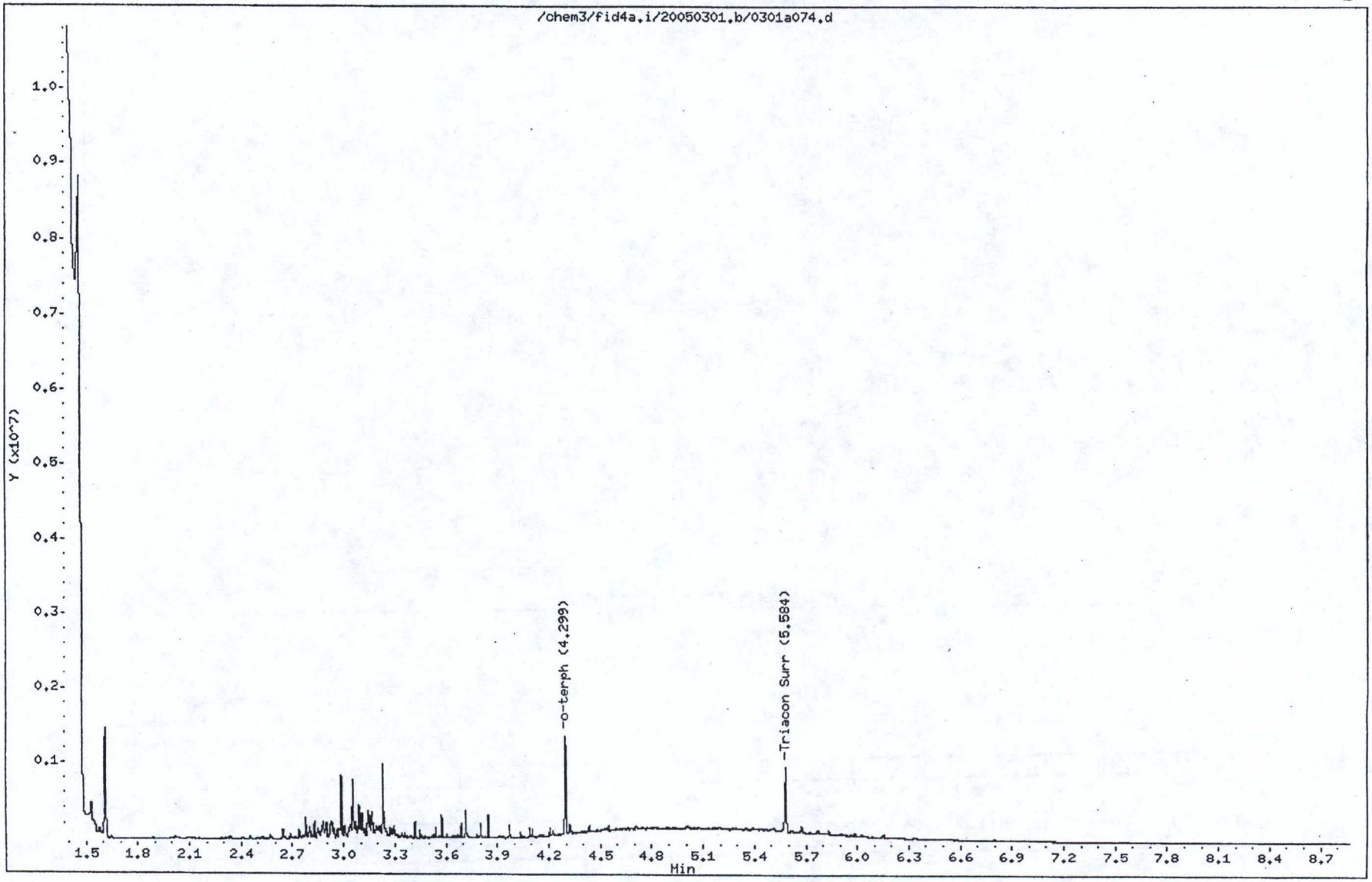
Sample Info: HS64P

Operator: PC

Column phase: RTX-1

Column diameter: 2.00

000354



Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
SB-07229r	P2ST-SB-PP029-0100	Soil	8	10	5.4	U	40		190	J	230	J

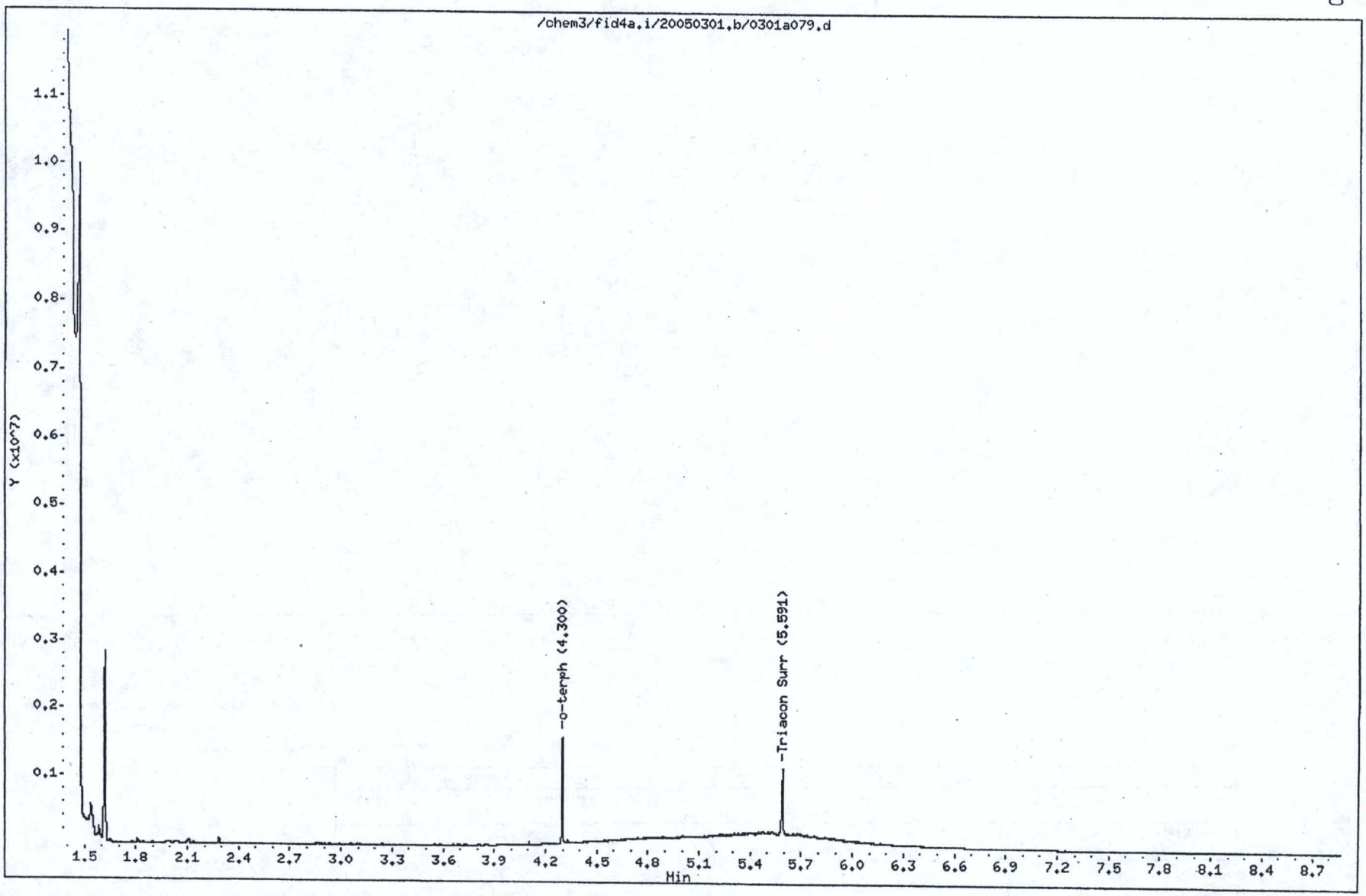
Data File: /chem3/fid4a.i/20050301.b/0301a079.d
Date : 02-MAR-2005 08:17
Client ID: P2ST-SB-PP029-0100
Sample Info: HS64Q

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

000356



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07230r	P2ST-SB-PP030-0120	Soil	10	12	55		71		180	J	306	J

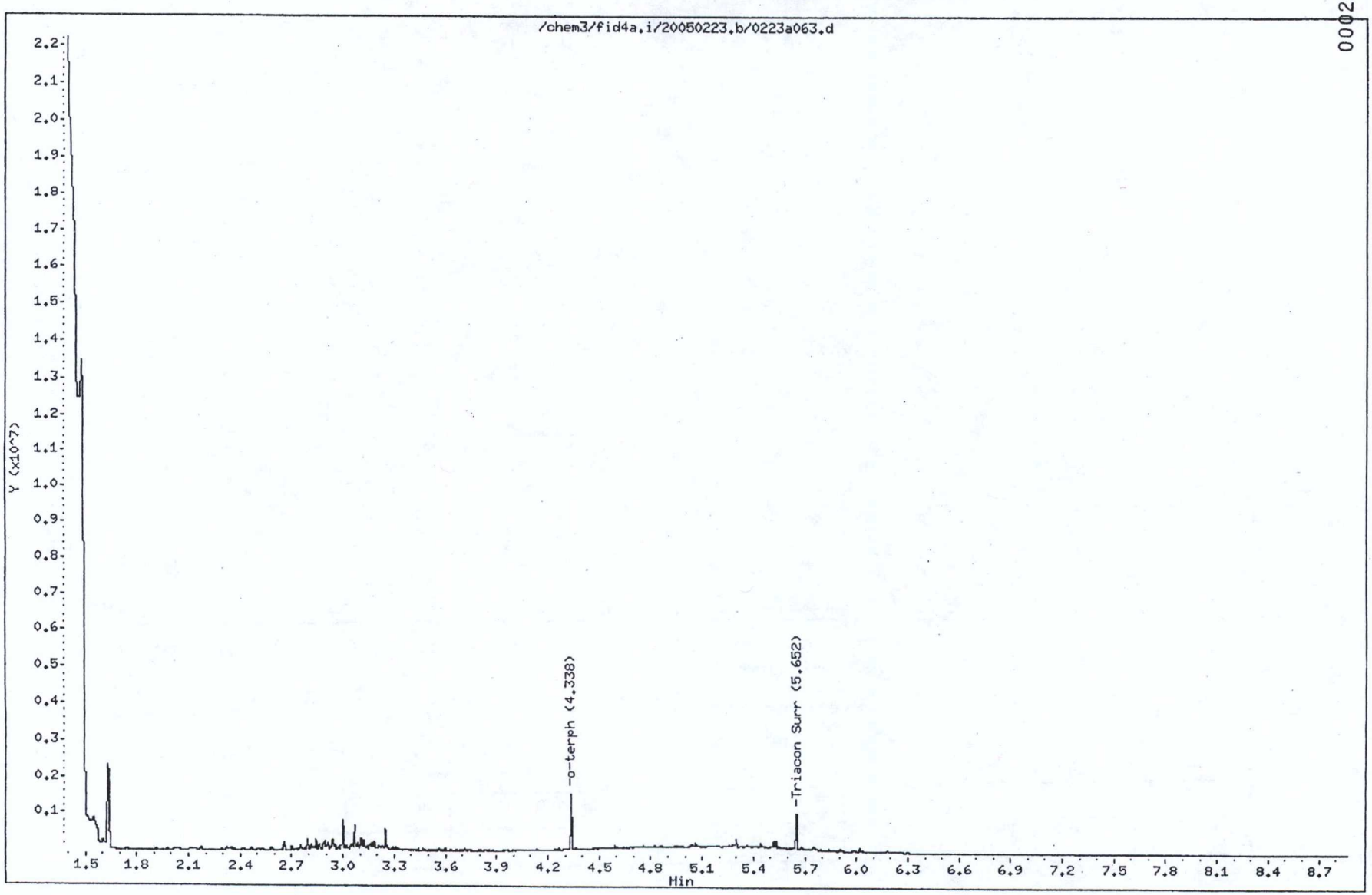
Data File: /chem3/fid4a.i/20050223.b/0223a063.d
Date : 24-FEB-2005 04:05
Client ID: P2ST-SB-PP030-0120
Sample Info: HS65C

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

000233



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07232r	P2ST-SB-PP032-0120	Soil	10	12	370		960		2400	J	3,730	J

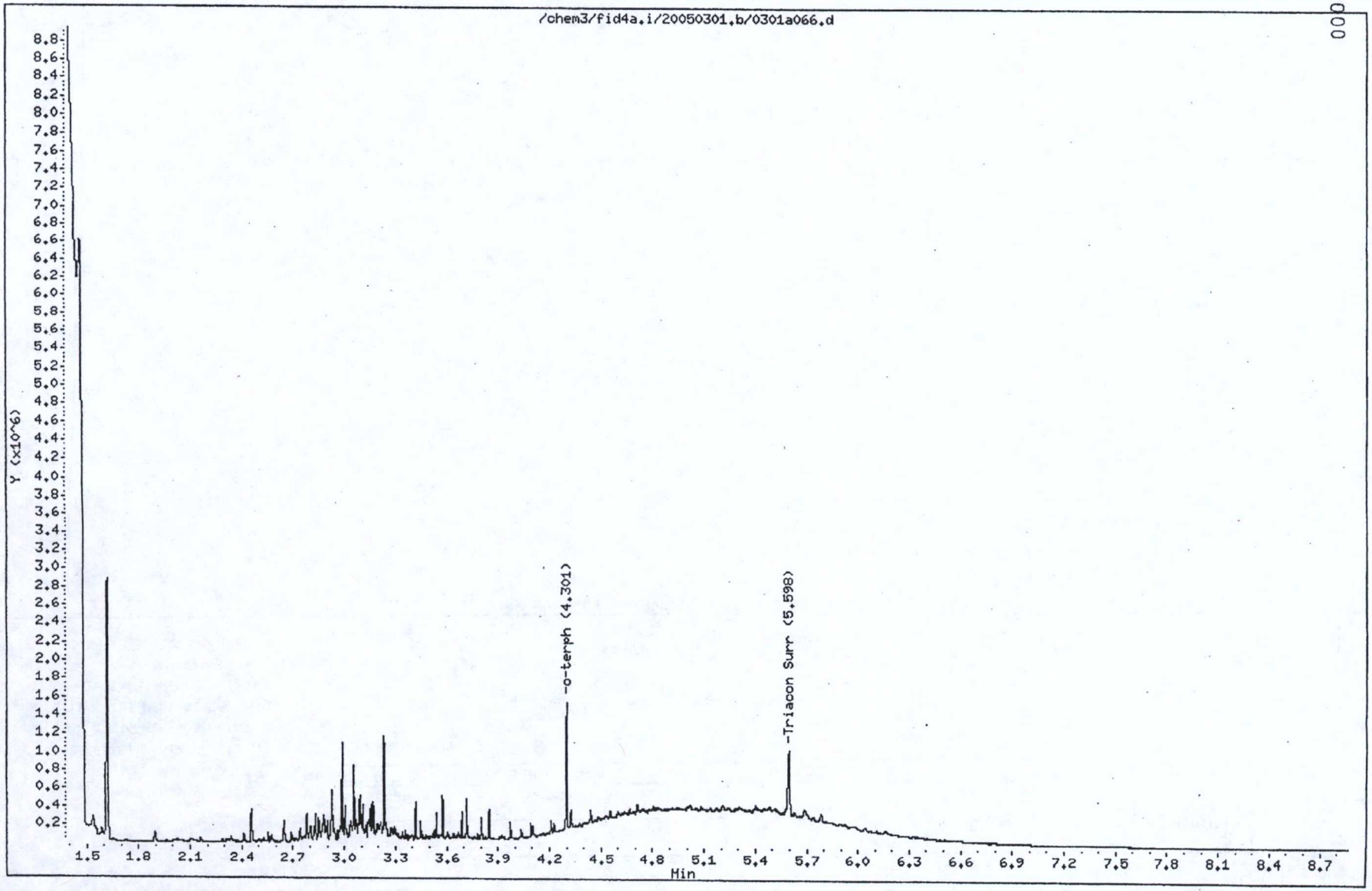
Data File: /chem3/fid4a.i/20050301.b/0301a066.d
Date : 02-MAR-2005 04:52
Client ID: P2ST-SB-PP032-0120
Sample Info: HS64H

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

000338



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07232r	P2ST-SB-PP032-0140	Soil	12	14	240		650		1700	J	2,590	J

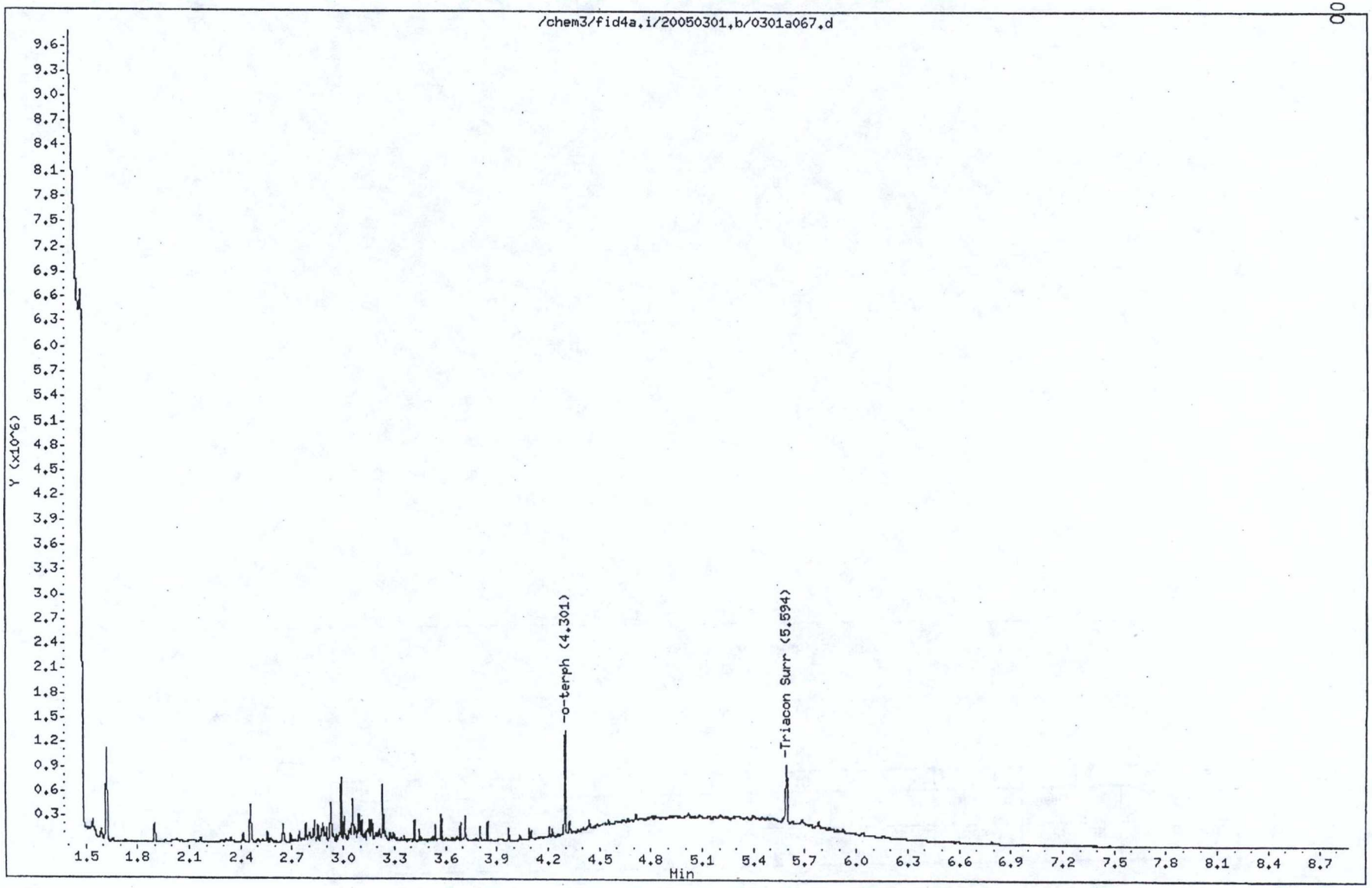
Data File: /chem3/fid4a.i/20050301.b/0301a067.d
Date : 02-MAR-2005 05:08
Client ID: P2ST-SB-PP032-0140
Sample Info: HS64I

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

000340



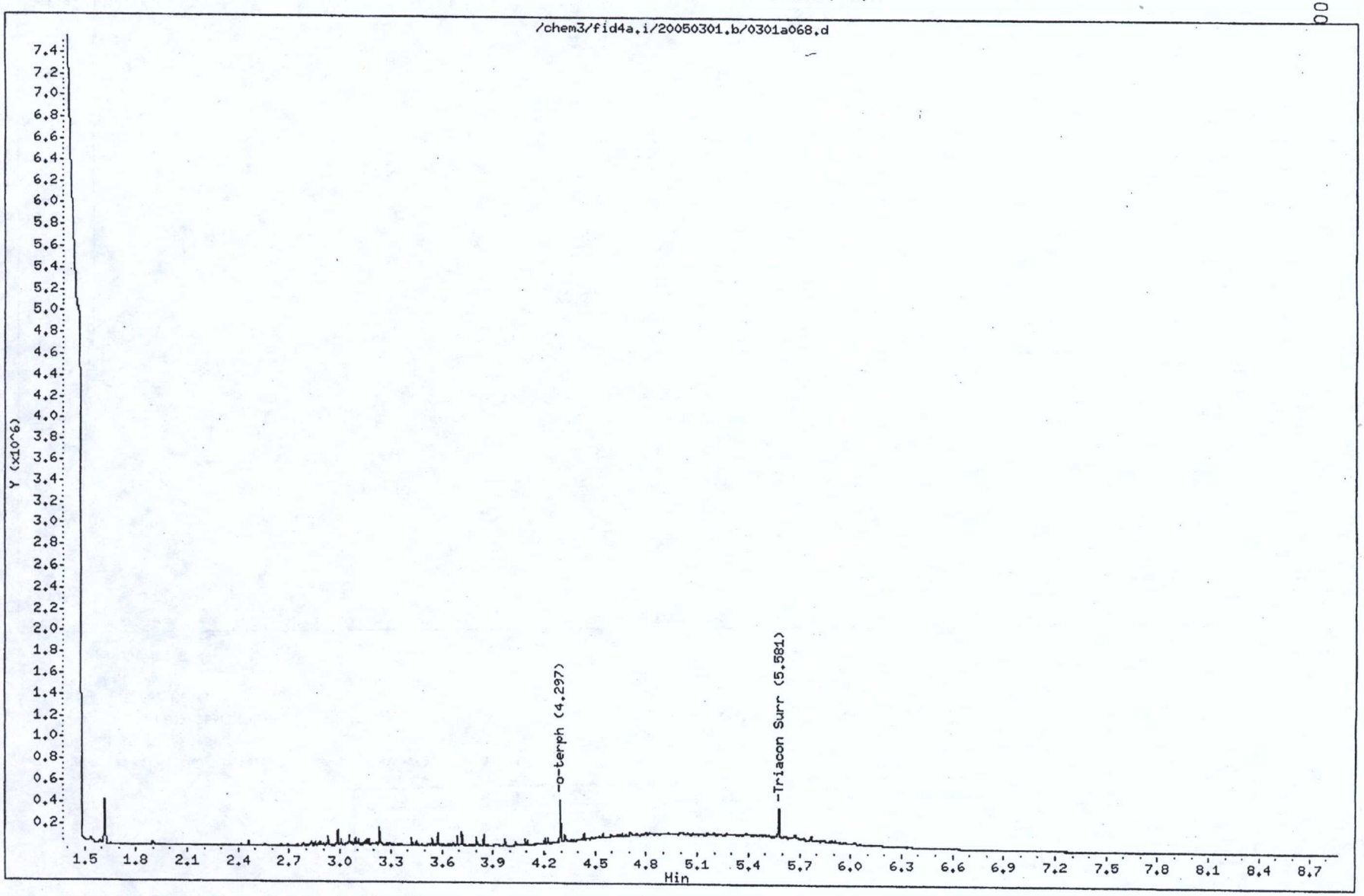
Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07232r	P2ST-SB-PP032-0160	Soil	14	16	230		1400		3700	J	5,330	J

Data File: /chem3/fid4a.i/20050301.b/0301a068.d
Date : 02-MAR-2005 05:23
Client ID: P2ST-SB-PP032-0160
Sample Info: HS64J,5

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07248	P2ST-SB-PP048-0020	Soil	0	2	110	U	210		2400	J	2,610	J

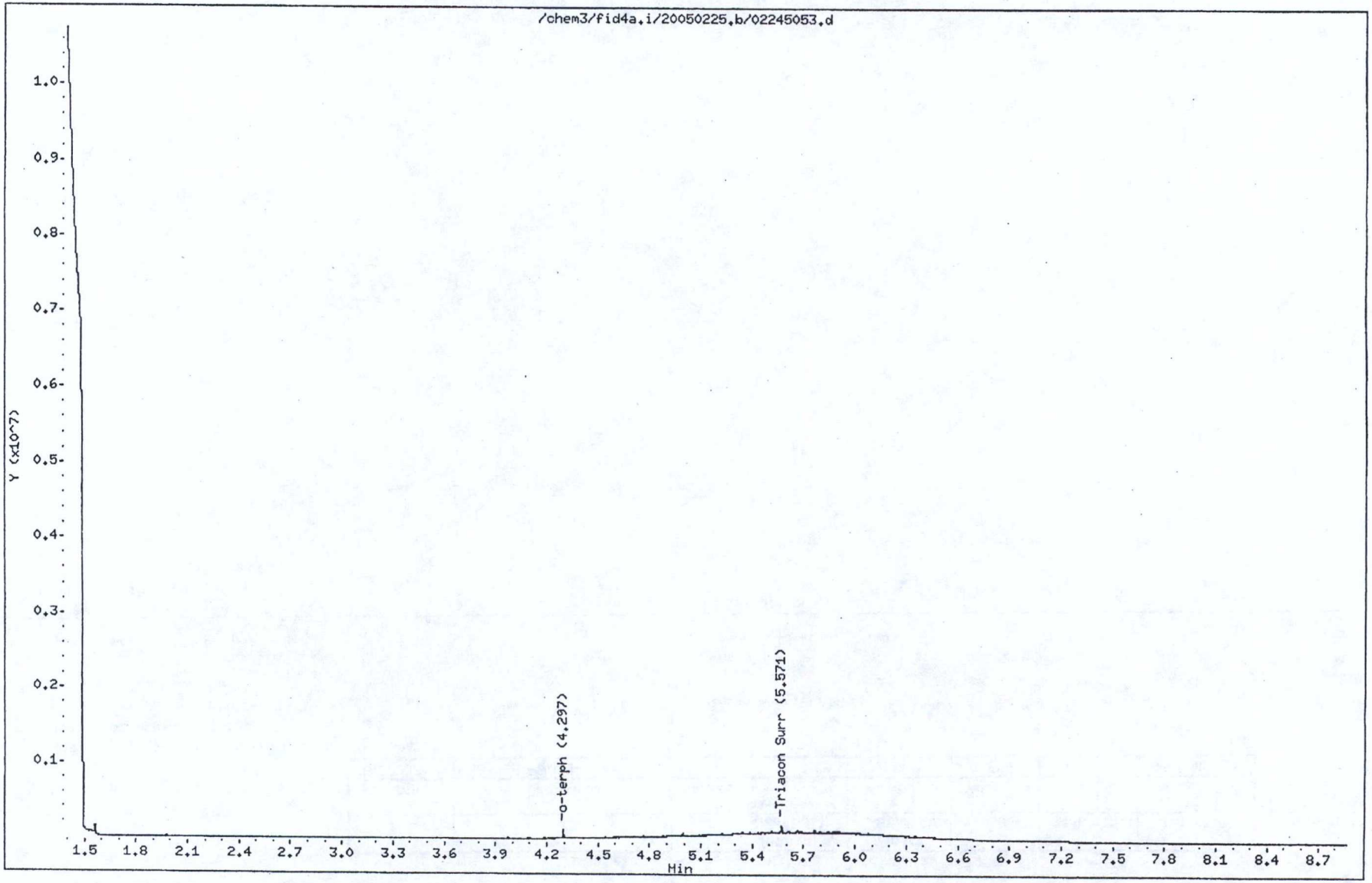
Data File: /chem3/fid4a.i/20050225.b/02245053.d
Date : 26-FEB-2005 03:59
Client ID: P2ST-SB-PP048-0020
Sample Info: HS63A,10

Column phase: RTX-1

Instrument: fid4a.i

Operator: ESJ
Column diameter: 2.00

000325



Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
SB-07233r	P2ST-SB-PP033-0080	Soil	6	8	2900		9000		19000	J	30,900	J

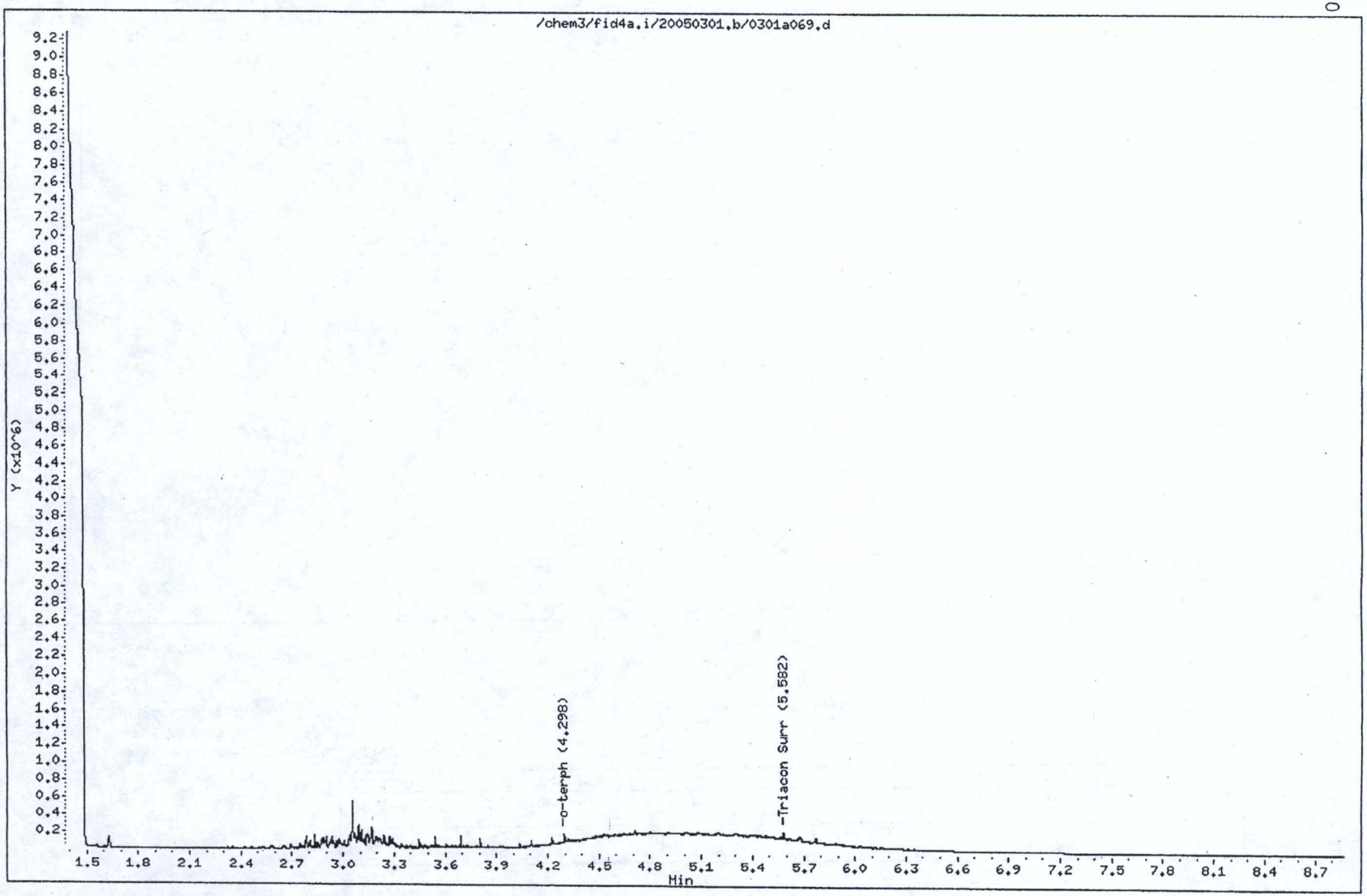
Data File: /chem3/fid4a.i/20050301.b/0301a069.d
Date : 02-MAR-2005 05:39
Client ID: P2ST-SB-PP033-0080
Sample Info: HS64K,20

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

Column phase: RTX-1

0003444



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07233r	P2ST-SB-PP033-0100	Soil	8	10	2200		7600		16000	J	**25,800**	J

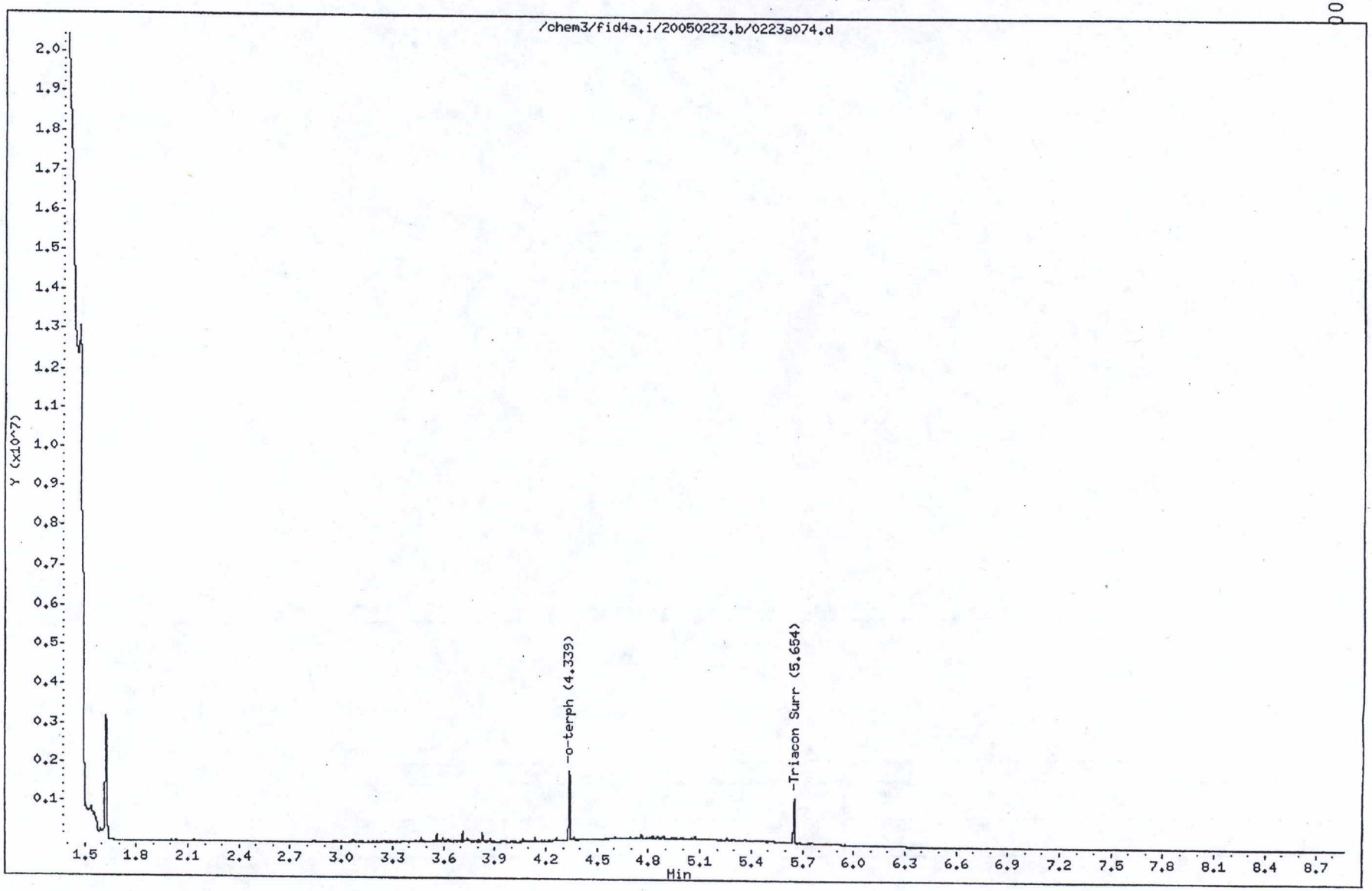
Data File: /chem3/fid4a.i/20050223.b/0223a074.d
Date : 24-FEB-2005 06:58
Client ID: P2ST-SB-PP050-0100
Sample Info: HS65J

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

000247



Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
SB-07233r	P2ST-SB-PP033-0140	Soil	12	14	350		1400		3700	J	5,450	J

Data File: /chem3/fid4a.i/20050301.b/0301a072.d

Date : 02-MAR-2005 06:26

Client ID: P2ST-SB-PP033-0140

Sample Info: HS64N,5

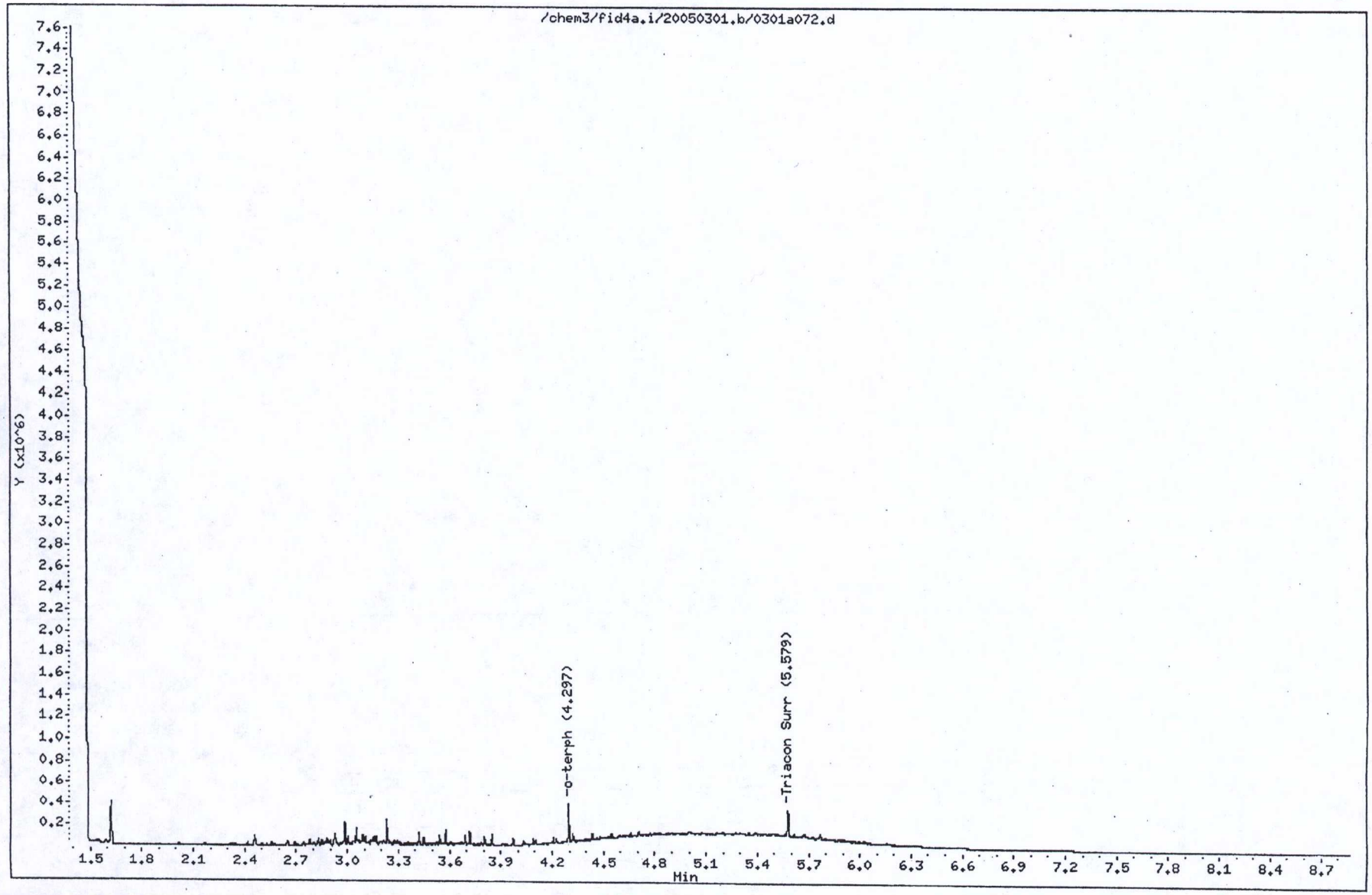
Instrument: fid4a.i

Operator: PC

Column phase: RTX-1

Column diameter: 2.00

000350



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07233r	P2ST-SB-PP033-0160	Soil	14	16	32	U	310		870	J	1,180	J

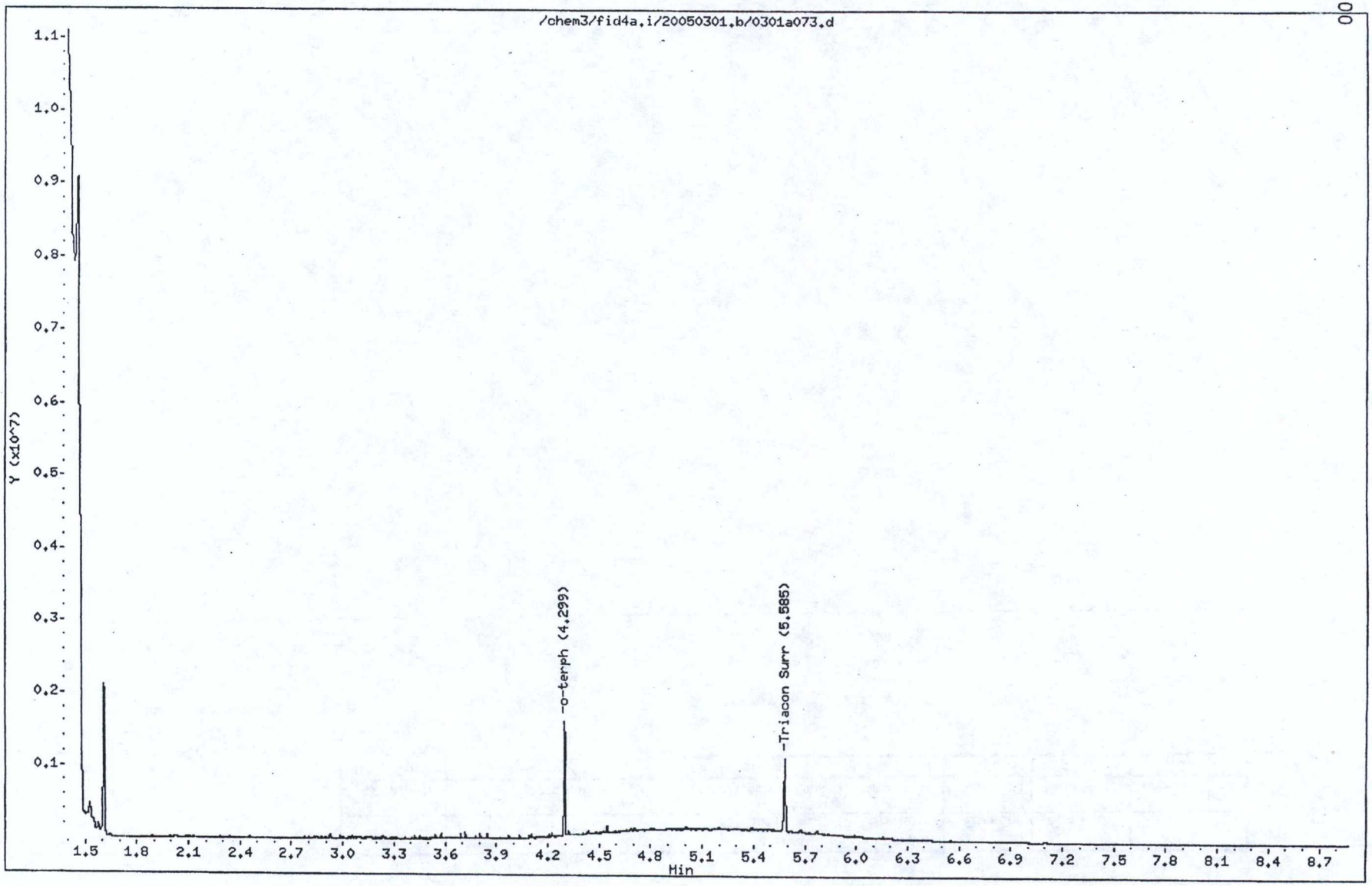
Data File: /chem3/fid4a.i/20050301.b/0301a073.d
Date : 02-MAR-2005 06:42
Client ID: P2ST-SB-PP033-0160
Sample Info: HS640

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00

000352



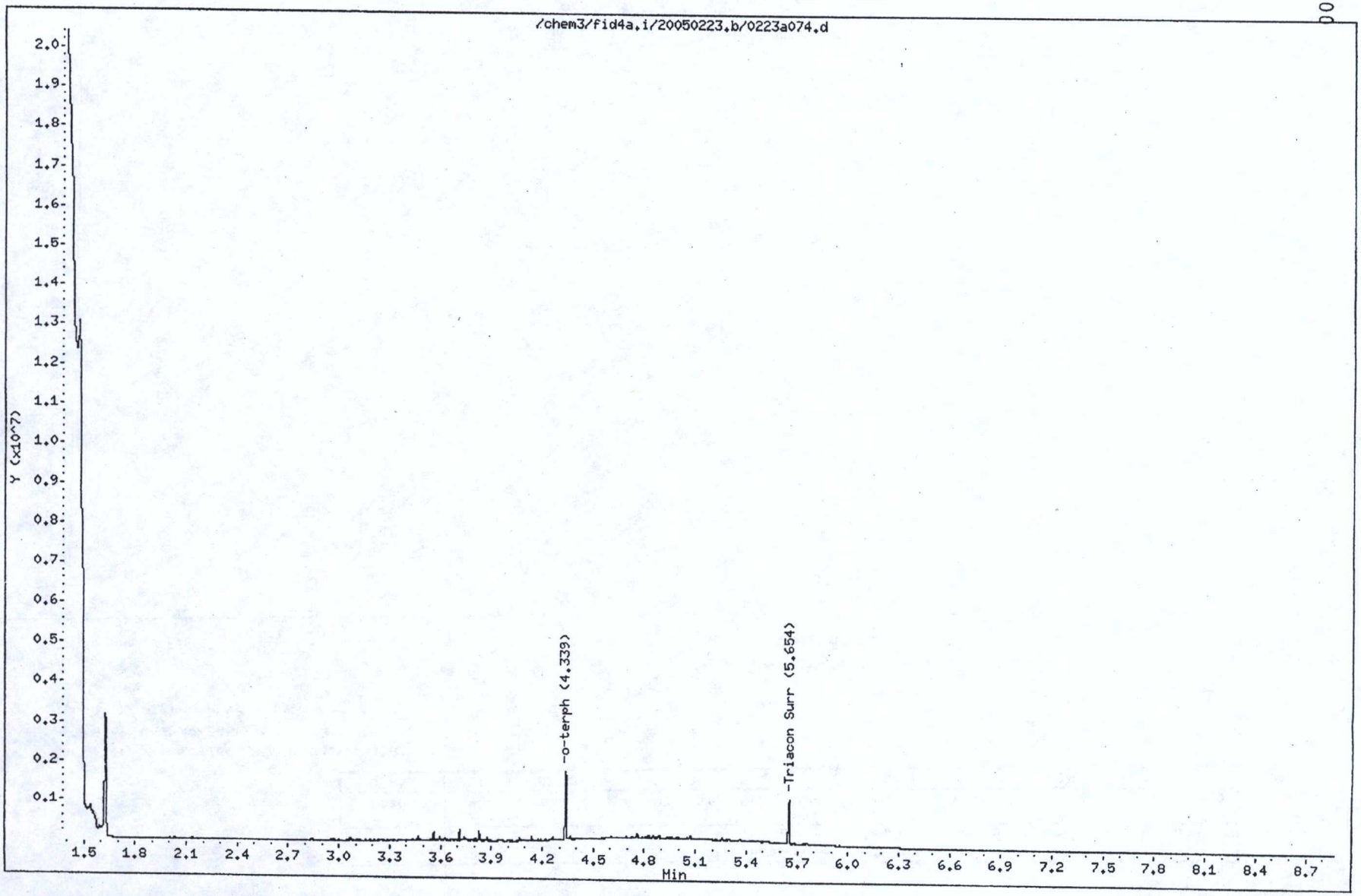
Location	Sample ID	Matrix	Interval (feet bgs) Upper Limit	Interval (feet bgs) Lower Limit	Mineral Spirits Value	Mineral Spirits Q	Diesel Value	Diesel Q	Motor Oil Value	Motor Oil Q	Total TPH Value	Total TPH Q
SB-07250	P2ST-SB-PP050-0100	Soil	8	10	8		98		140	J	246	J

Data File: /chem3/fid4a.i/20050223.b/0223a074.d
Date : 24-FEB-2005 06:58
Client ID: P2ST-SB-PP050-0100
Sample Info: HS65J

Column phase: RTX-1

Instrument: fid4a.i

Operator: PC
Column diameter: 2.00



Location	Sample ID	Matrix	Interval (feet bgs)		Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q
SB-07250	P2ST-SB-PP050-0040	Soil	2	4	12		280		380	J	672	J

Data File: /chem3/fid4a.i/20050223.b/0223a071.d

Date : 24-FEB-2005 06:11

Client ID: P2ST-SB-PP050-0040

Sample Info: HS65G

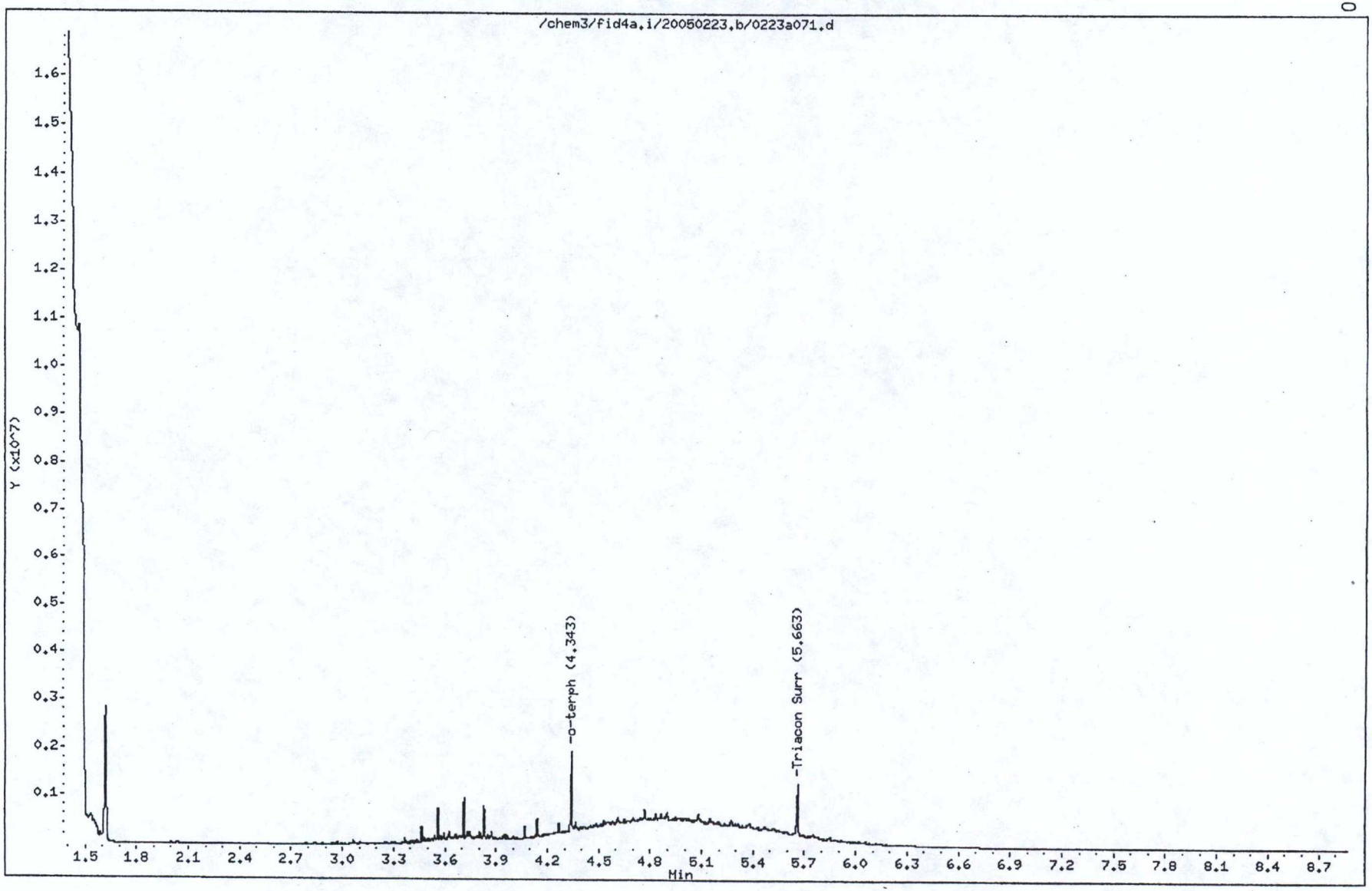
Column phase: RTX-1

Instrument: fid4a.i

Operator: PC

Column diameter: 2.00

0002411



Groundwater Samples

Total TPH > 1.0 mg/L

Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
PL2-006AR	P2ST-GW-MW006AR-0000	GW	2.7		2.7		0.47		5.87	

Data File: /chem3/fid3b.i/20050301.b/0301b072.d

Date : 02-MAR-2005 13:26

Client ID: P2St-GW-MW006AR-0000

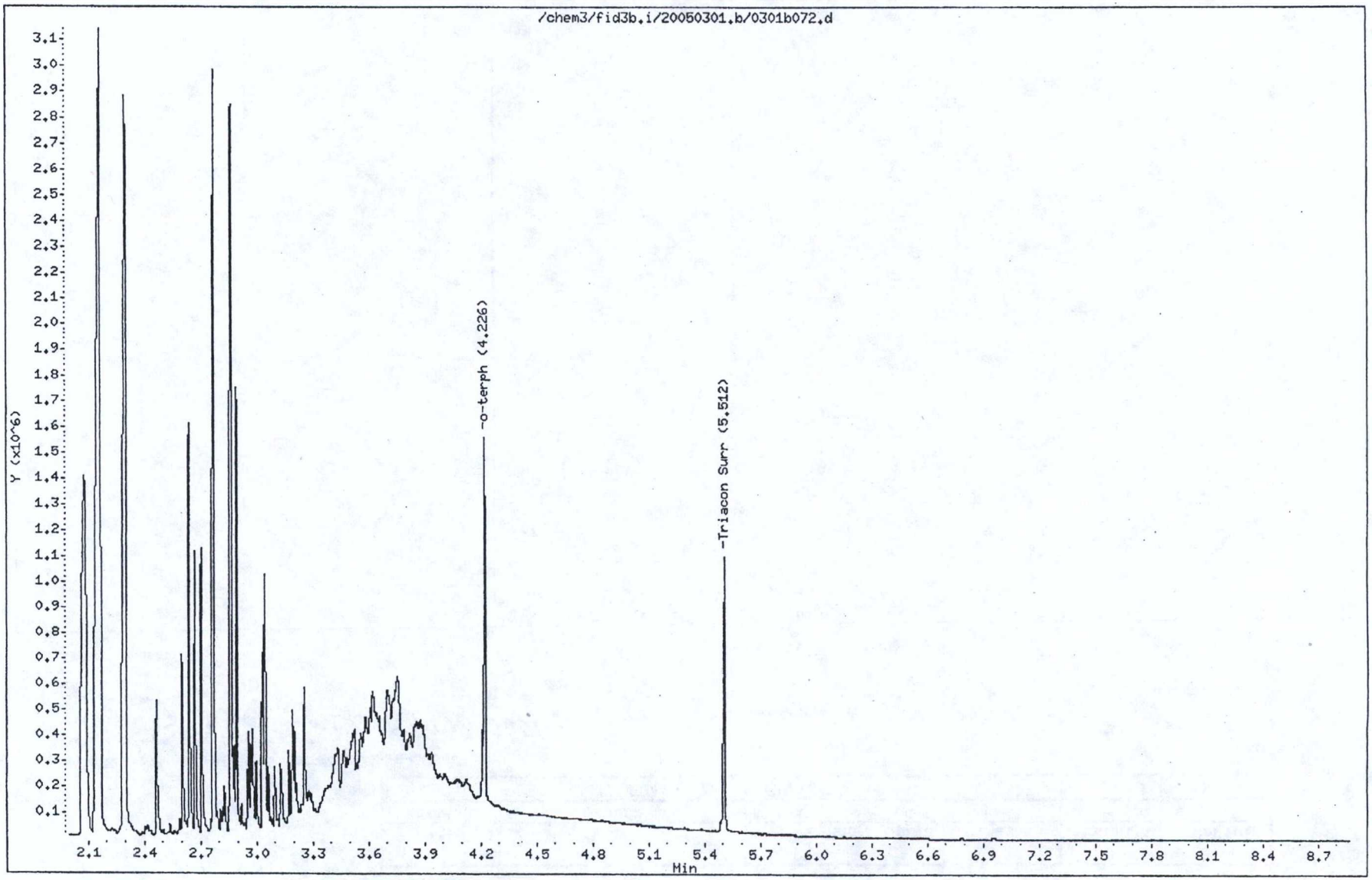
Sample Info: HT27B

Instrument: fid3b.i

Operator: JR

Column phase: RTX-1

Column diameter: 2.00



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
PL2-JF04A	P2ST-GW-MWJF04A-0000	GW	0.35		0.73		0.5	U	1.08	

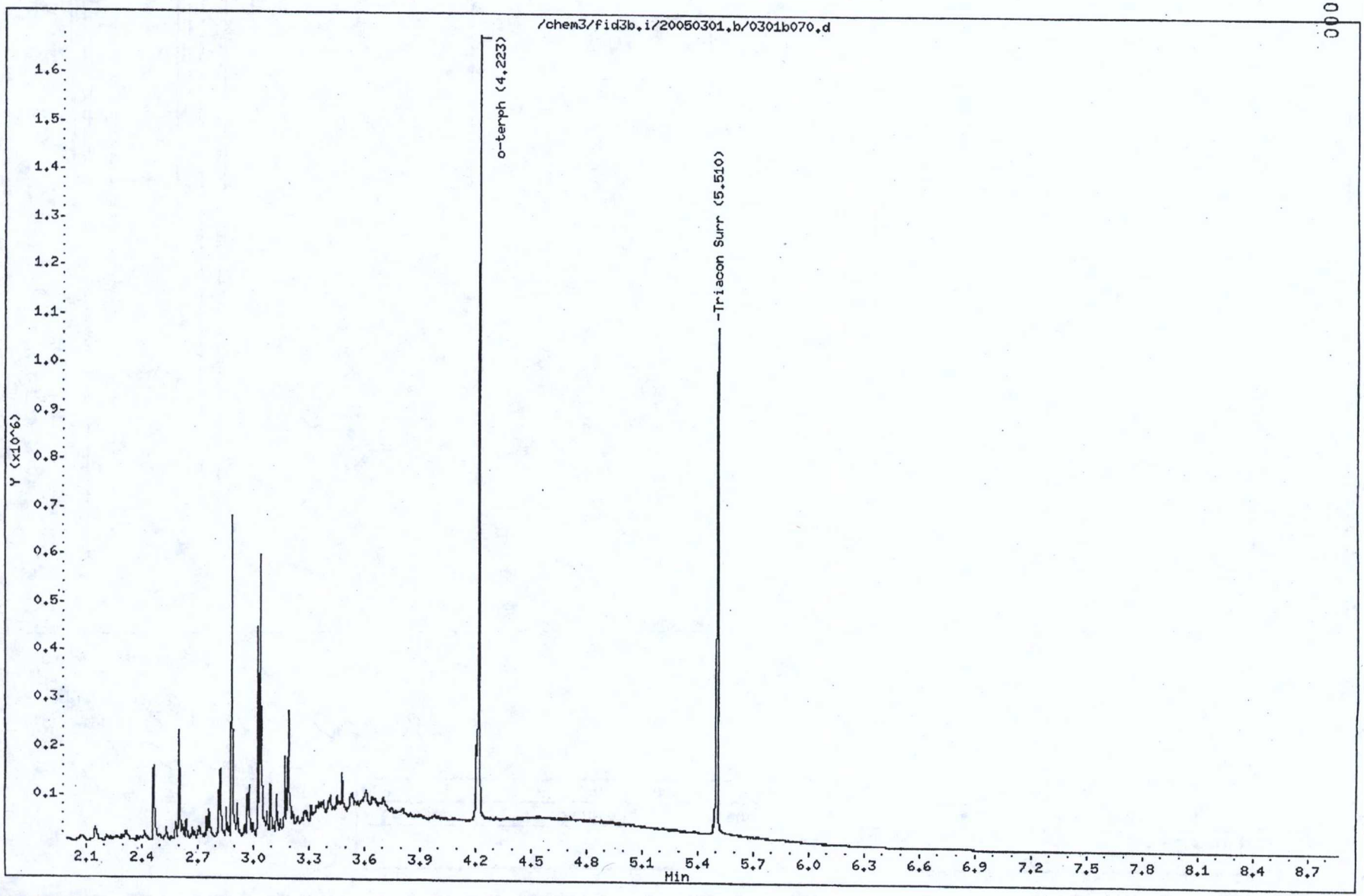
Data File: /chem3/fid3b.i/20050301.b/0301b070.d
Date : 02-MAR-2005 12:52
Client ID: P2ST-GW-MWJF04A-0000
Sample Info: HT28A

Instrument: fid3b.i

Operator: JR
Column diameter: 2.00

Column phase: RTX-1

000135



Catch Basin Samples

Total TPH > 200 mg/kg

Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD001	P2SC-GR-SD001-0000	solids	130	U	4,400	J	9,600	J	14,000	J

Data File: /chem3/fid3a.i/20050519.b/0519a009.d

Date : 19-MAY-2005 16:41

Client ID:

Sample Info: IA51A2,4

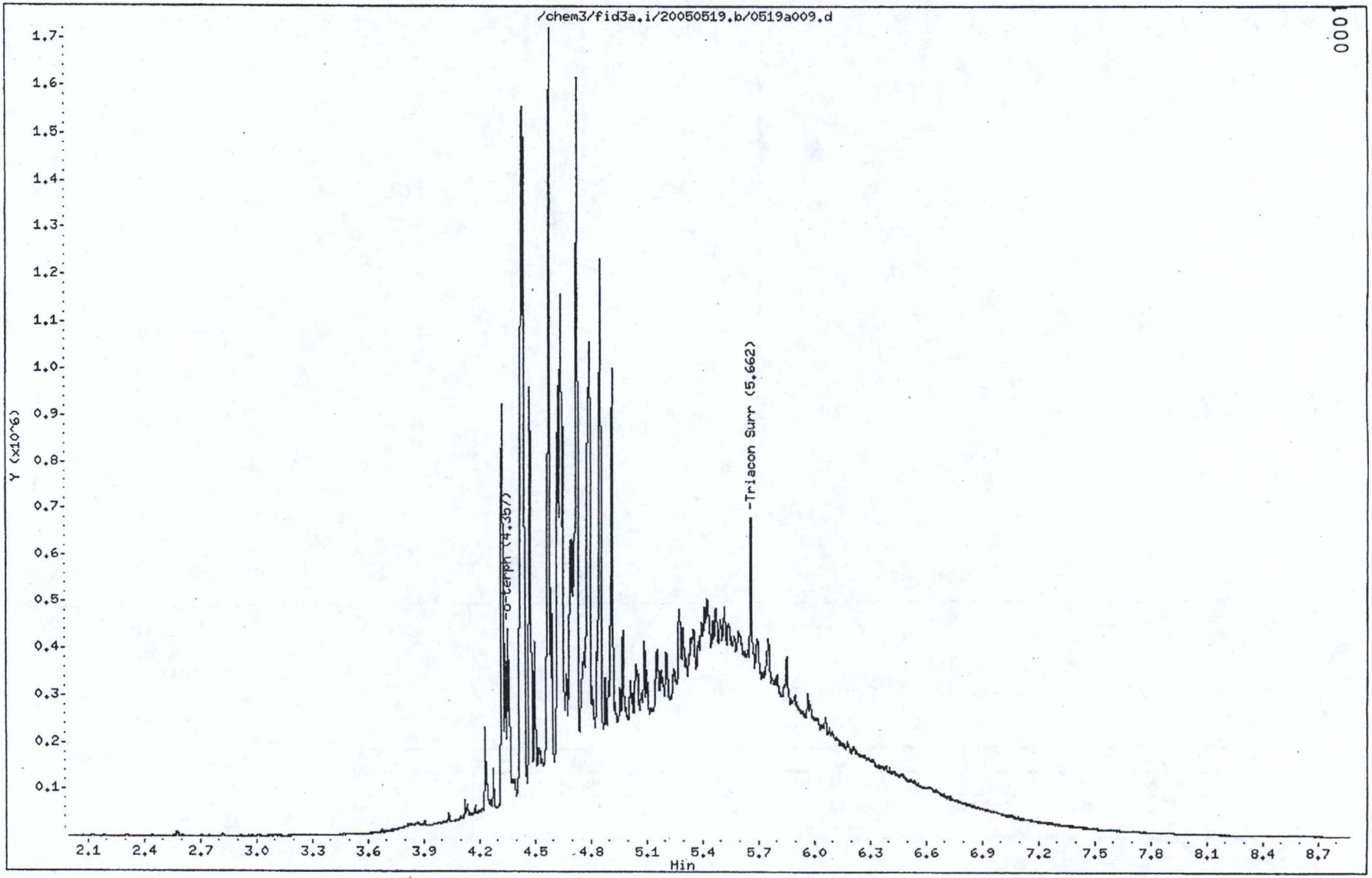
Column phase: RTX-1

Instrument: fid3a.i

Operator: AR

Column diameter: 2.00

000166



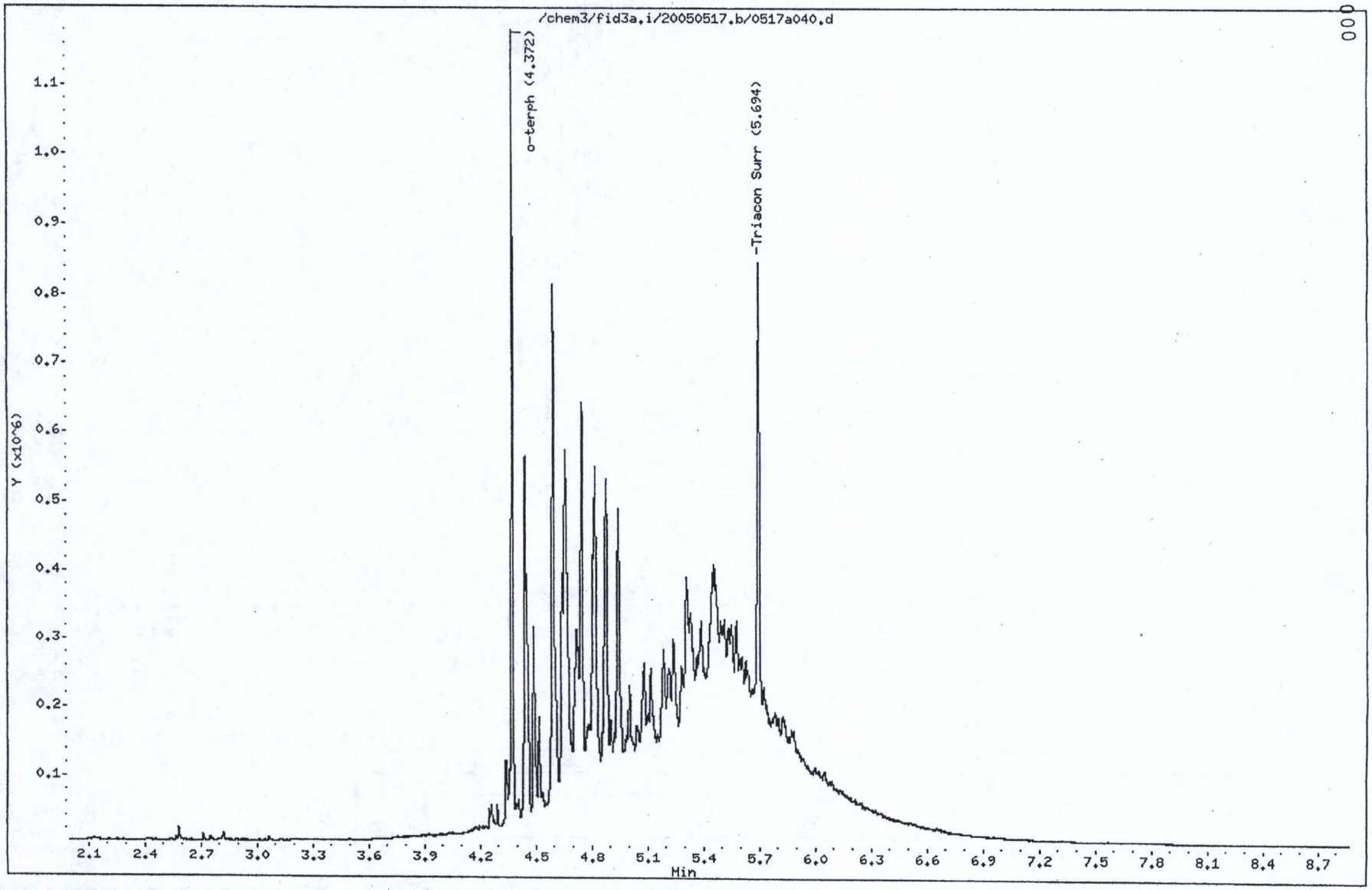
Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD002	P2SC-GR-SD002-0000	solids	29	U	430	J	1,100	J	1,530	J

Data File: /chem3/fid3a.i/20050517.b/0517a040.d
Date : 17-MAY-2005 20:52
Client ID:
Sample Info: IA51C2

Column phase: RTX-1

Instrument: fid3a.i

Operator: AR
Column diameter: 2.00



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD003	P2SC-GR-SD003-0000	solids	120	U	1,000	J	4,600	J	5,600	J

Data File: /chem3/fid3a.i/20050517.b/0517a037.d

Date : 17-MAY-2005 20:06

Client ID:

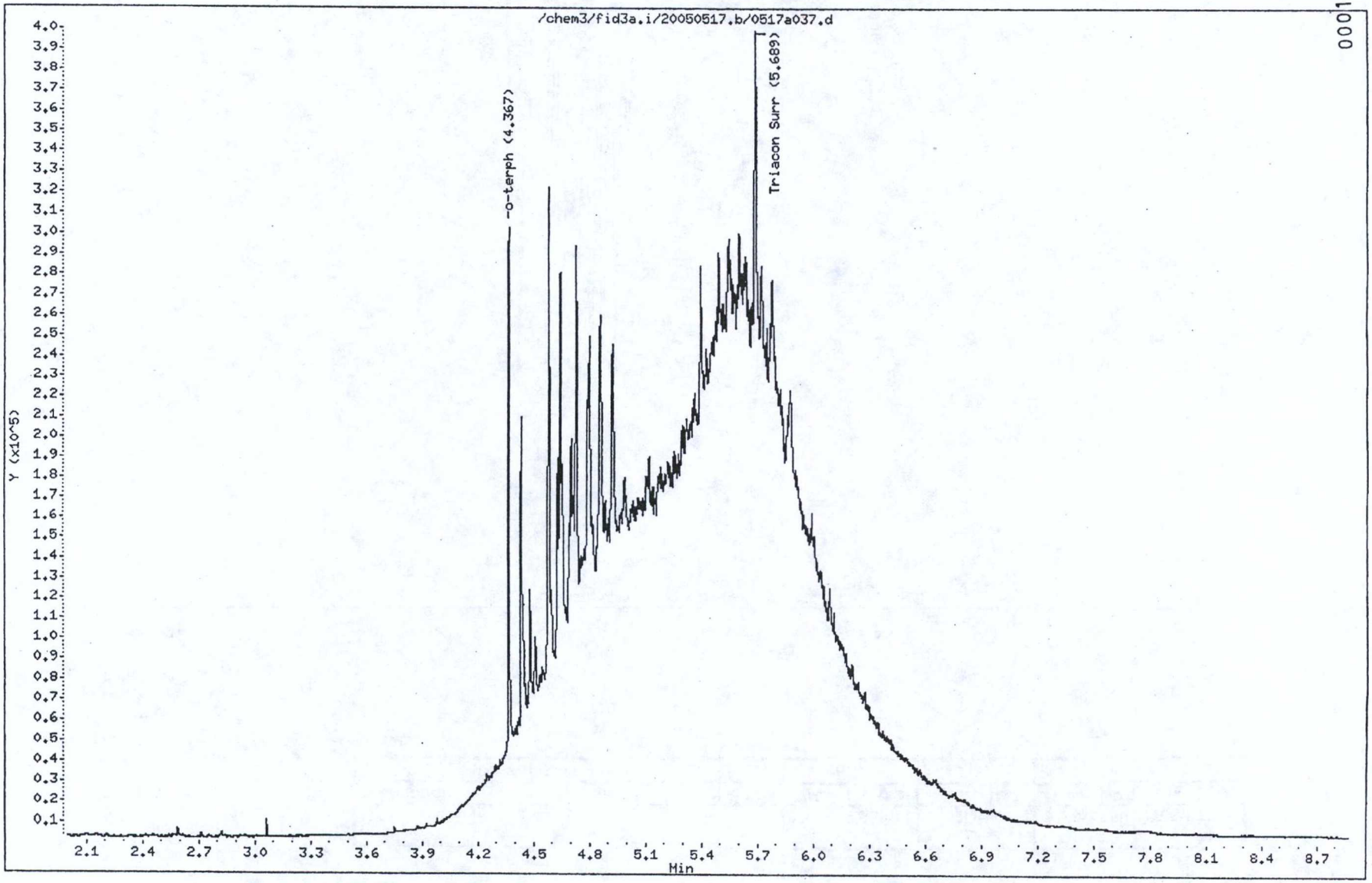
Sample Info: IA51B2,5

Instrument: fid3a.i

Operator: AR

Column phase: RTX-1

Column diameter: 2.00



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD004	P2SC-GR-SD004-0000	solids	56	U	1,800	J	4,700	J	6,500	J

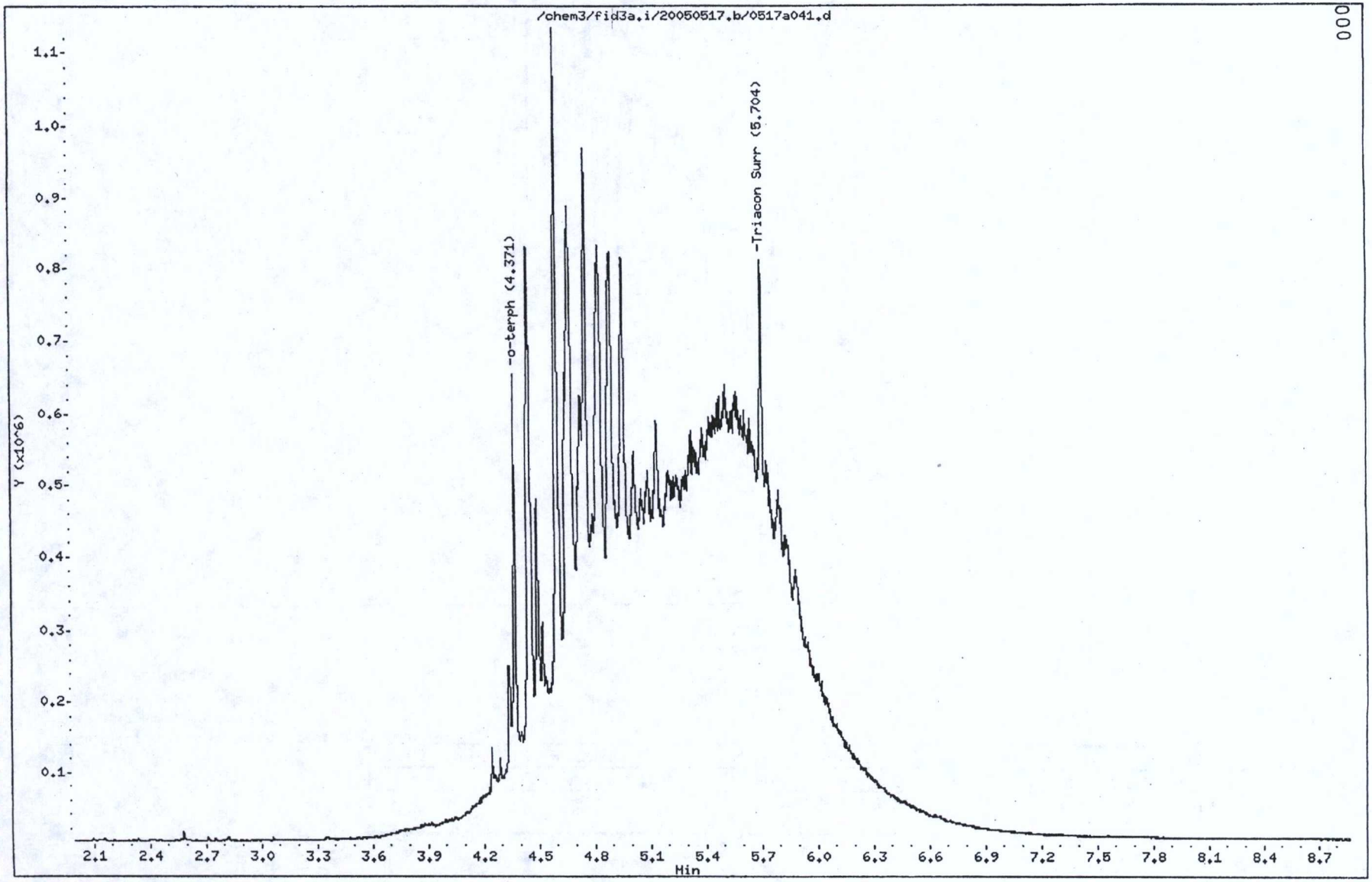
Data File: /chem3/fid3a.i/20050517.b/0517a041.d
Date : 17-MAY-2005 21:07
Client ID:
Sample Info: IA51D2,2

Instrument: fid3a.i

Operator: AR
Column diameter: 2.00

Column phase: RTX-1

000172



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD005	P2ST-GR-SD005-0000	solids	270	U	4,400		3,500		7,900	

Data File: /chem3/fid3a.i/20050517.b/0517a046.d

Date : 17-MAY-2005 22:23

Client ID:

Sample Info: IA52A,20

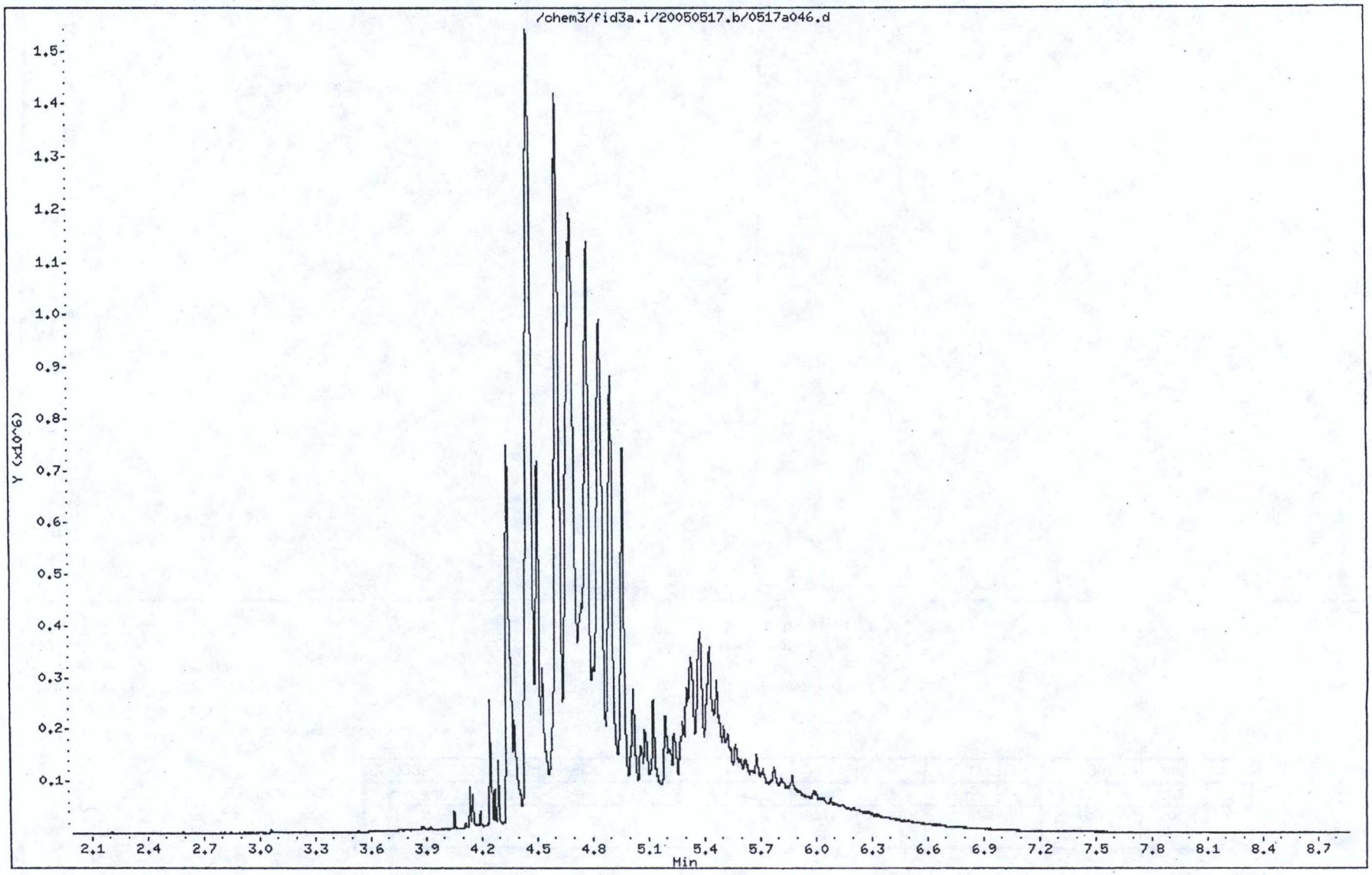
Column phase: RTX-1

Instrument: fid3a.i

Operator: AR

Column diameter: 2.00

000144



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
SD006	P2SC-GR-SD006-0000	solids	240	U	120	U	490		490	

Data File: /chem3/fid3a.i/20050607.b/0607a039.d

Date : 07-JUN-2005 22:03

Client ID:

Sample Info: IC83A,20

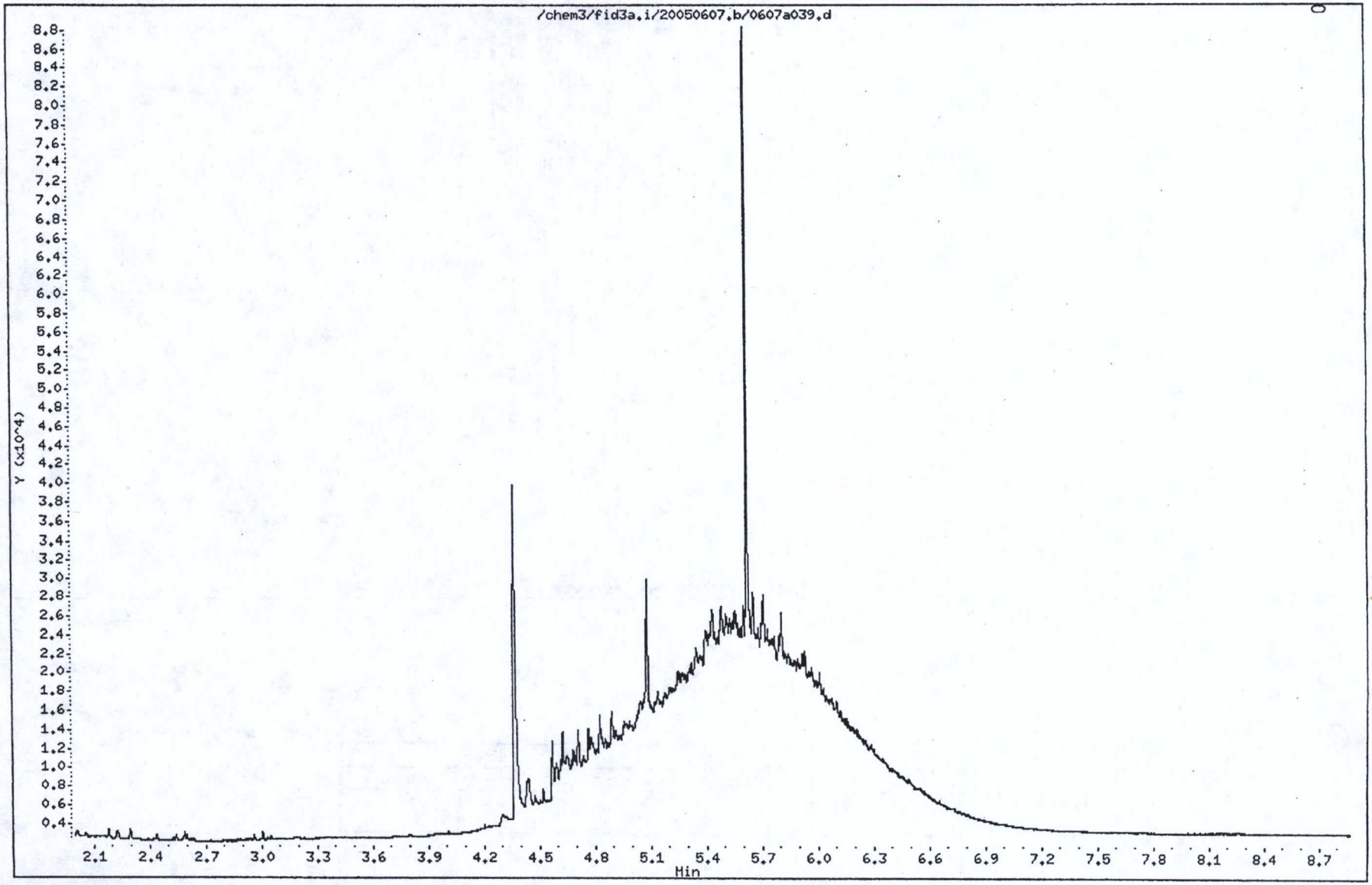
Instrument: fid3a.i

Operator: AR

Column phase: RTX-1

Column diameter: 2.00

000173



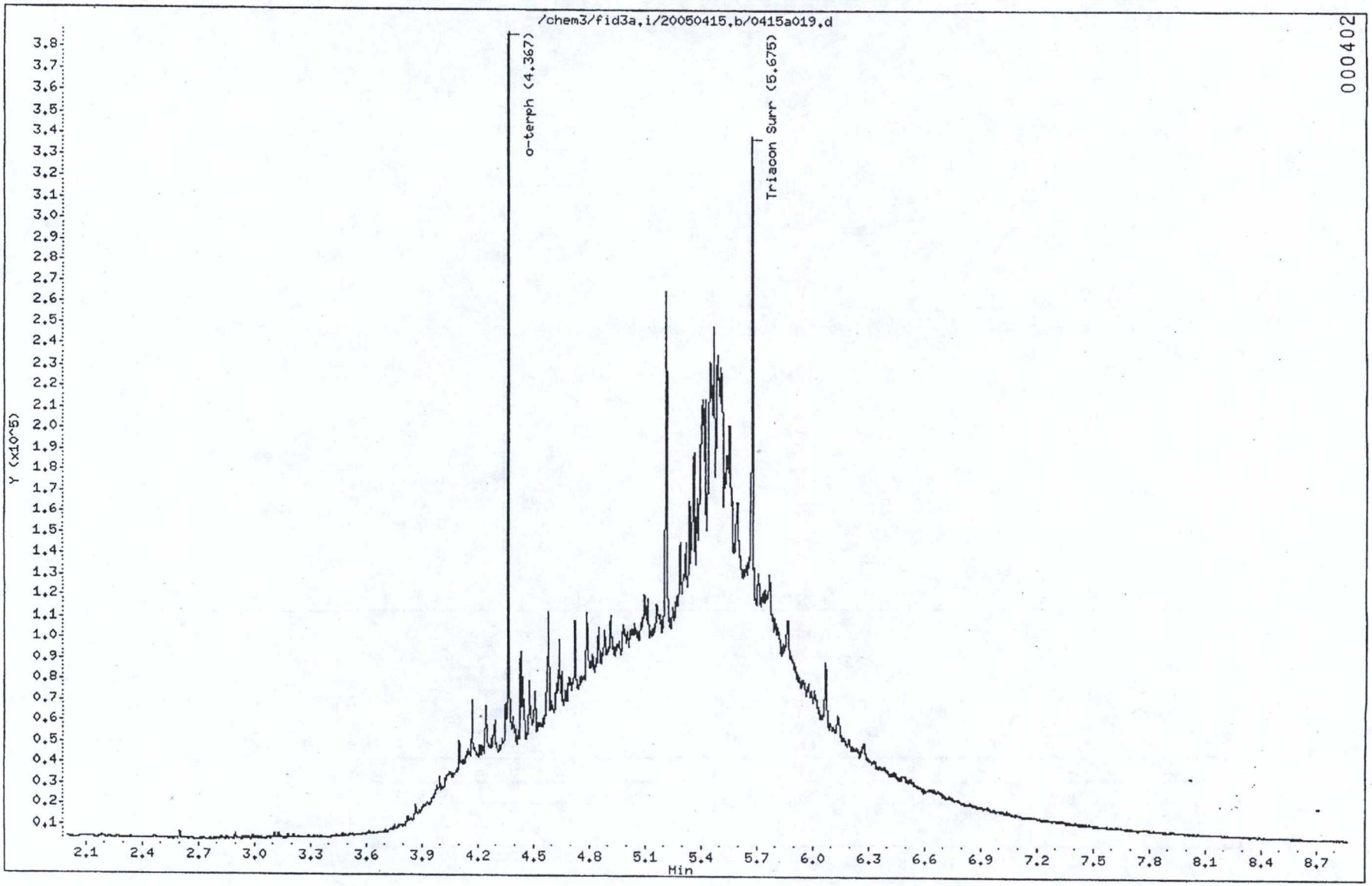
Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
CB010	P2ST-GR-CB010-0000	solids	57	U	220		680	J	900	J

Data File: /chem3/fid3a.i/20050415.b/0415a019.d
Date : 15-APR-2005 19:40
Client ID: P2ST-GR-CB010-0000
Sample Info: HY13B,5

Column phase: RTX-1

Instrument: fid3a.i

Operator: AR
Column diameter: 2.00



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
CB011	P2ST-GR-CB011-0000	solids	11	U	42		160	J	202	J

Data File: /chem3/fid3a.i/20050415.b/0415a020.d

Date : 15-APR-2005 19:55

Client ID: P2ST-GR-CB011-0000

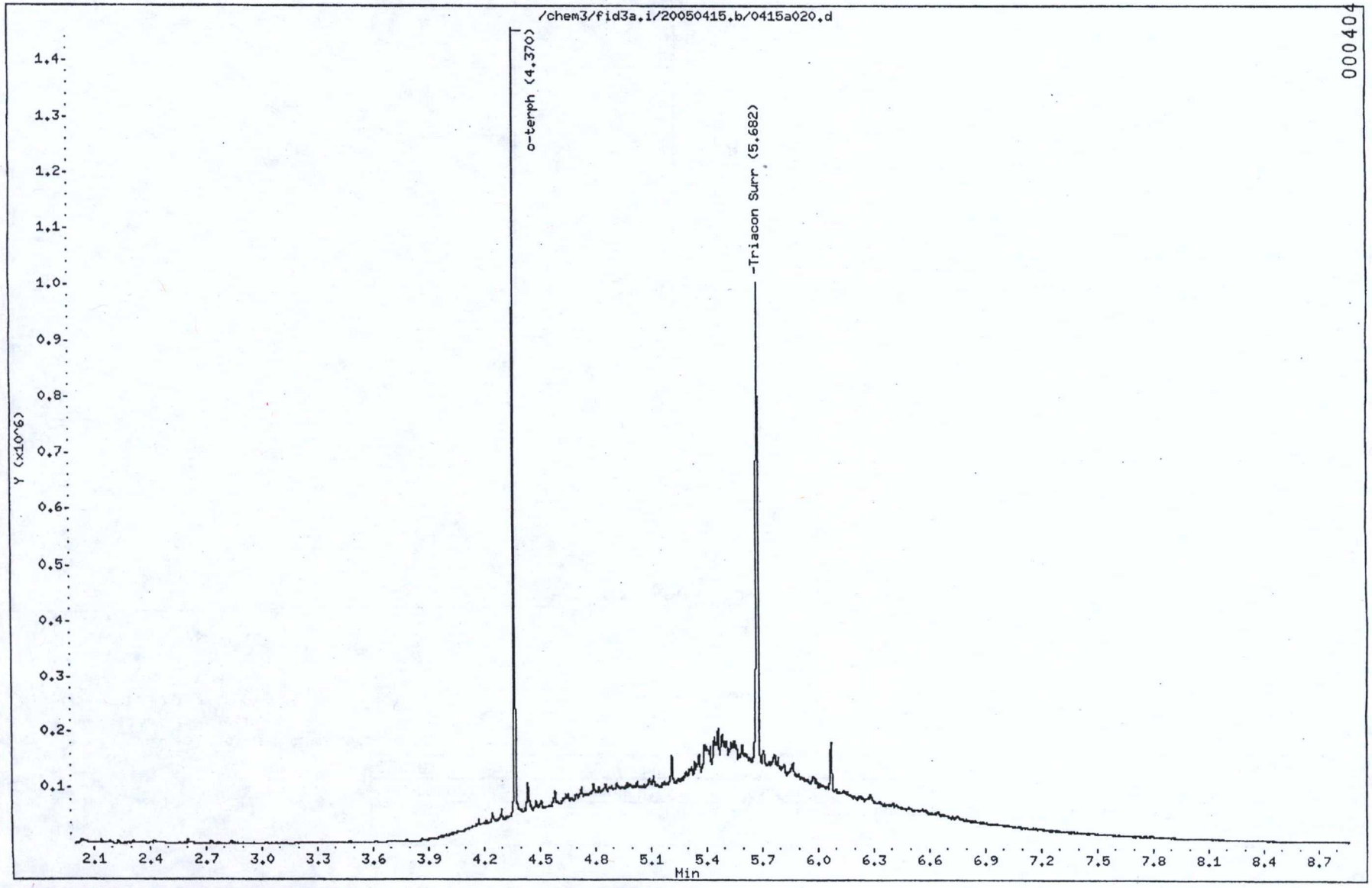
Sample Info: HY13C

Column phase: RTX-1

Instrument: fid3a.i

Operator: AR

Column diameter: 2.00



Location	Sample ID	Matrix	Mineral Spirits		Diesel		Motor Oil		Total TPH	
			Value	Q	Value	Q	Value	Q	Value	Q
CB012	P2ST-GR-CB012-0000	solids	12	U	180		440	J	620	J

Data File: /chem3/fid3a.i/20050415.b/0415a021.d

Date : 15-APR-2005 20:10

Client ID: P2ST-GR-CB012-0000

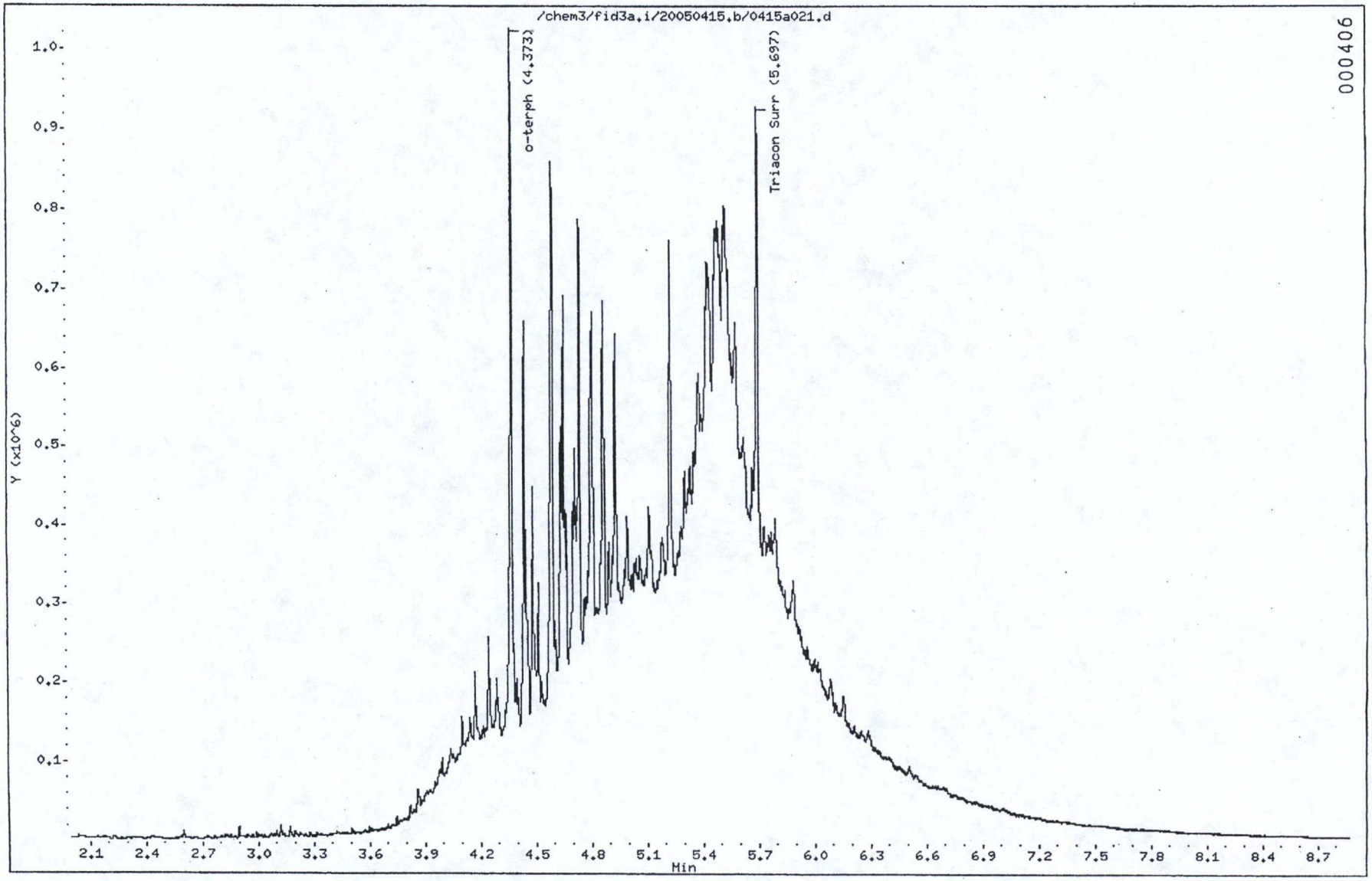
Sample Info: HY13D

Column phase: RTX-1

Instrument: fid3a.i

Operator: AR

Column diameter: 2.00



Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Appendix E
Contouring Methodology

August 3, 2005

1.0 Contouring Methodology

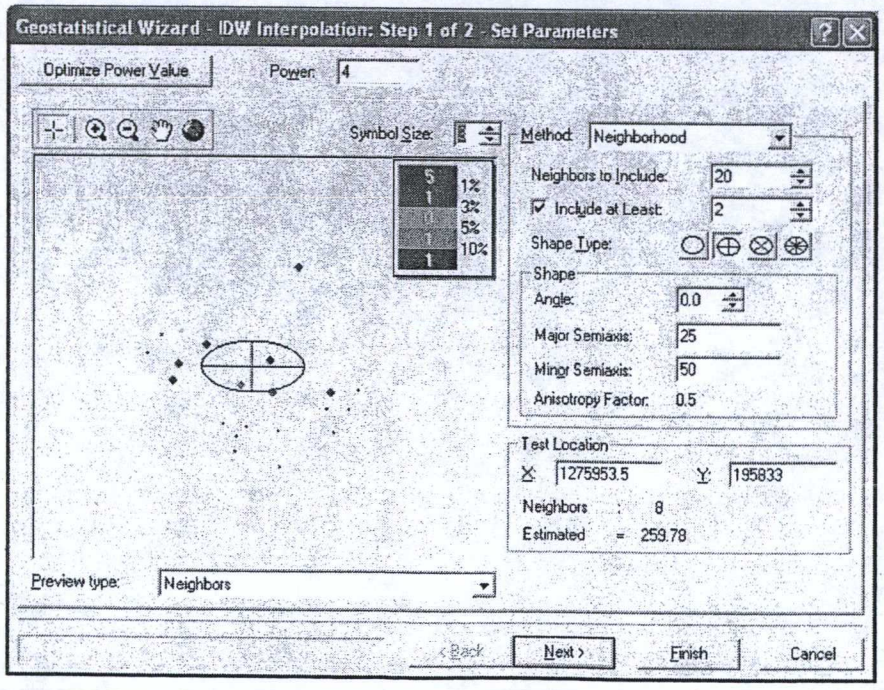
The concentrations of Total PCBs and TPH in soil were contoured with ESRI's Geostatistical Analyst using the Inverse Distance Weighted (IDW) spatial interpolation method. IDW is a two dimensional interpolation method that uses measured sample points from a study area to create accurate predictions for other unmeasured locations within the same area. The measured value (Z value) in this case was the detected dry weight concentration of either total PCBs or TPH. If the analyte was not detected, the reporting limit was used. Additionally, where two or more results were recorded within a depth interval being contoured the mean was calculated and used.

1.1 IDW PARAMETERS FOR SOIL

IDW has a number of parameters that can be adjusted to best characterize the surface being interpolated. Power in IDW controls the influence that neighboring points have on the interpolated values of a grid cell. To reduce the number of stations where there would be a noticeable difference between the interpolated value of a grid cell and an actual sample result within a grid cell a power value of 4 was used.

The orientation and size of the search ellipse controls which neighboring points are used in the interpolation of each grid value. To best represent the anisotrophic effects occurring at the site the size of the search ellipse was set to 50 feet by 25 feet (major and minor axes, respectively), with the orientation angle unchanged at 0°. Within these constraints the search ellipse was broken into four sectors, using at least two locations and up to a maximum of fifty.

The following screen dump illustrates how the parameters are populated in the Geostatistical Analyst:



1.2 SEDIMENT CONTOURING METHODOLOGY

The methodology for contouring sediments follows that laid out in Geospatial Technical Working Group memo (refer to following memo) with one exception. The grid size was reduced, from 10 feet by 10 feet to 0.25 feet by 0.25 feet, to enhance contour smoothing and to match the resolution of the upland contours.

MCS Environmental, Inc.
6505 – 216th Street SW, Suite 100
Mountlake Terrace, WA 98043
425-697-4340 (voice) • 425-697-4370 (fax)

MEMORANDUM

DATE: **April 27, 2005**

TO: **Howard Orlean (EPA)**
William D. Ernst (Boeing)
Michael J. Gleason (Boeing)

FROM: **Geospatial Technical Working Group**

RE: **PCB contouring methodology for the South Boeing Plant 2 and Jorgensen Forge Waterfront Geospatial Analysis**
MCS# 34004.011

This memo provides a description of the methods used in the geospatial interpolation of PCB concentrations in surface and subsurface sediments in the Duwamish Waterway adjacent to the South Boeing Plant 2 Southwest Yard and the Jorgensen Forge Waterfront property. Data from the Boeing Plant 2 Vertical Characterization of the Duwamish Sediment Other Area (DSOA), the Transformer Investigation, the Upriver (Area 1 Investigation) and the EPA Triad studies were used in a layered 2-D geospatial interpolation of Aroclor 1248, Aroclor 1254, Aroclor 1260, and total PCB concentrations. Dry weight Aroclor concentrations from EPA Method 8082 analysis were used in the interpolation and contouring. Total PCB concentrations were summed using the SMS rules.

These geospatial analyses were conducted solely for the purposes of aiding in the development of an upriver boundary for the DSOA. The results of these analysis are not intended to be used for any remedial design activities.

DATA FILES

Surface samples were collected using grab samplers (van Veen) and hand collection methods. Subsurface samples were collected using cores. Cores were typically segmented into 1-foot sections and identified by the depth interval (i.e., 0 ft to 1 ft, 1 ft to 2 ft, 2 ft to 3 ft segment). Only selected core segments were initially analyzed from each core. PCB and Aroclor values for depth

intervals that were not collected were assigned surrogate values using the following fill down methods.

- Deeper core segments missing analytical values were filled in by carrying down the analyte concentration of the next shallowest segment analyzed.
- If a deeper sample has a higher concentration (concentration increases with depth) the higher concentration was not filled up.
- Surface or shallow subsurface samples were not assigned surrogate concentrations based on a deeper sample result.
- The data file was filled down to the 4-5 ft segment even if the deeper core segments were not collected.
- Sample points for each 2-d layer were coded on the figures as actual (filled circles) and filled in or surrogate (triangles) data. Filled data is identified as extrapolated on the geospatial interpolation figures legend.

Multiple cores or grabs collected at a single station and identified as field duplicates were offset by a minimum of 1 ft and were plotted as separate data points. Field splits (homogenized sample divided into 2 samples and analyzed separately) were assigned the higher concentration value.

Geospatial interpolation was conducted using the reporting limit for undetected Aroclors.

Underlying database files are available on the included CD-ROM.

SEARCH NEIGHBORHOOD PARAMETERS

In several meetings, the technical work group developed consensus parameters, which follow. The geospatial analysis used Inverse Distance Weighting (IDW) on a 10 ft by 10 ft grid. The following search neighborhood parameters were used in the geospatial interpolation. The south Boeing Plant 2 and the Jorgensen Forge waterfront area were divided into three sub-areas during the analysis to accommodate differences in the data density and the river channel orientation. (Note that the nomenclature used here is distinct from, and should not be confused with, earlier references to Area I, Area A, etc. referring to the zones where various parties were collecting samples.) The number of sample locations adjacent to the Southwest Yard at Boeing Plant 2 (Area 1) is less than the number of samples adjacent to the Jorgensen Forge property. The size of the search ellipse was increased to 150 ft and 75 ft (major and minor axes, respectively) for the geospatial interpolation adjacent to the Boeing Southwest Yard. The search ellipse was oriented parallel with the river flow (147.5 °N). The search ellipses used in Area 2 and Area 3 adjacent to the Jorgensen Forge property

were smaller (100 ft and 50ft for major and minor axes, respectively) and oriented at 147.5 °N (Area 2) and 166 °N (Area 3) (Figure 1).

The orientation and size of the search ellipse controls which neighboring points are used in the interpolation of each grid value. The search ellipse orientation is independent of the north south grid cell orientation (established by default). Each search ellipse around a grid cell required a minimum of 2 neighbors (up to a maximum of 100) within the search ellipse for interpolation of a grid cell value. A buffer zone of 50 ft was used between Areas 1 and 2 and 100 ft between Area 2 and 3. Interpolated values for each grid cell were averaged within the buffer areas.

Power in IDW controls the influence that neighboring points have on the interpolated values of a grid cell. In IDW interpolation the influence of a neighboring point decreases with distance. Higher powers (2 and above) place increasing emphasis on the nearest points. A localized hot spot may unduly influence the interpolated value of surrounding grid cells at lower powers. Using a higher power (e.g., power of 4 used in this interpolation) reduces the number of stations where there is a noticeable difference between the interpolated value of a grid cell and an actual sample result within a grid cell (i.e., miscoding). Figure 2 illustrates the effect of different powers on a geospatial interpolation and provides examples of miscoding for a limited dataset.

GEOSPATIAL INTERPOLATIONS

Geospatial interpolations were made using the surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for selected Aroclors and total PCBs. The number of sampling locations with actual data below 5 ft was limited. Cores were not driven below 5 ft at several locations. Samples below 5 ft were seldom analyzed if shallower samples were below the SQS. In addition, deeper layers did not show interpolated concentrations that were significantly different from the 4-5 ft results. The following geospatial interpolations are presented:

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for Aroclor 1248 expressed as a percentage of the total PCBs Aroclor 1248 concentrations expressed as ppb dry weight is not presented because of elevated detection limits for Aroclor 1248 in some samples.

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for Aroclor 1254 expressed as a percentage of the total PCBs

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for Aroclor 1260 expressed as a percentage of the total PCBs

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for Aroclor 1254 expressed as ppb dry weight

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for Aroclor 1260 expressed as ppb dry weight

- 2-d layered interpolations of surface, 0-1 ft, 1-2 ft, 2-3 ft, 3-4 ft, and 4-5 ft results for total PCBs expressed as ppb dry weight

- Maximum value of Aroclor 1248, Aroclor 1254, Aroclor 1260, and total PCBs at any depth.

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Appendix F
Results for Storm Solids Analyzed for Waste Profiling

August 3, 2005

Table F.1
Storm Solids Sampling Results for Metals

Location	Sample ID	Location Description	Sample Date	Metals (mg/kg)															
				Arsenic		Barium		Cadmium		Chromium		Lead		Mercury		Selenium		Silver	
				Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
CB010	P2ST-GR-CB010-0000	MH 15A along 12" storm pipe on JF: composite sample from top and bottom layers.	4/8/2005	0.2	U	0.38		0.01		0.02	U	0.2		0.0001	U	0.2	U	0.02	U
CB011	P2ST-GR-CB011-0000	MH 15A along 12" storm pipe on JF: sample from top 9" layer of slag/gravel atop sand layer at base of manhole.	4/8/2005	30	U	42		1	U	387		100		0.23		30	U	2	U
CB012	P2ST-GR-CB012-0000	MH 15A along 12" storm pipe on JF: sample from 3" sand layer at base of manhole.	4/8/2005	20		132		3.7		133		477		0.6		20	U	1	U

Notes:

U Indicates the compound was undetected at the reported concentration.

Table F.2
Storm Solids Sampling Results for SVOCs

Location	Sample ID	Location Description	Sample Date	Interval (inches below pile)		Semi-Volatile Organic Carbons (µg/kg)																							
						Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Fluoranthene		Fluorene		Indeno(1,2,3-cd)pyrene		Naphthalene		Pyrene	
				Upper Limit	Lower Limit	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q	Value	Q
CB009	P2ST-GR-CB009-0000	6-inch pipe into MH 36-83.	4/8/2005	0	1	280	U	280	U	280	U	280	U	280	U	280	U	280	U	280	U	280	U	280	U	280	U
CB010	P2ST-GR-CB010-0000	MH 15A along 12" storm pipe on JF: composite sample from top and bottom layers.	4/8/2005	0	12	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U
CB011	P2ST-GR-CB011-0000	MH 15A along 12" storm pipe on JF: sample from top 9" layer of slag/gravel atop sand layer at base of manhole.	4/8/2005	0	9	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U	64	U
CB012	P2ST-GR-CB012-0000	MH 15A along 12" storm pipe on JF: sample from 3" sand layer at base of manhole.	4/8/2005	9	12	130		98		95		130		160		66	U	250		66	U	92		66	U	230	

Notes:

U Indicates the compound was undetected at the reported concentration.

MH Manhole.

BOEING

Boeing Plant 2
Seattle, Washington

Phase II Transformer PCB Investigation Report

Appendix G
Data Validation Report

August 3, 2005

NOTE:

The following Data Validation Report includes five storm solids samples that are not discussed in the Phase II report, as these samples were collected outside of the Transformer Investigation Area. These samples were collected as part of a broader source control effort, but due to safety concerns and accessibility, Boeing collected them contemporaneously with the storm solid samples collected as part of the Phase II Transformer PCB Work Plan. Reporting of the results for these samples were provided graphically to the Agencies in July 2005. These five samples have the following sample IDs:

P2SC-GR-SD001-000
P2SC-GR-SD002-000
P2SC-GR-SD003-000
P2SC-GR-SD004-000
P2SC-GR-SD006-000

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Sayler Data Solutions, Inc.

DATA VALIDATION REPORT

Boeing SCL Transformer Investigation, Phase II Data

Prepared for:
Floyd Snider, Inc.
601 Union Street, Suite 600
Seattle, WA 98101

June 30, 2005

1.0 Introduction

Data validation was performed on the following laboratory data packages:

Lab Report Numbers	Sample Dates	Report Dates
HS63	2/14/05	3/7/05
HS64	2/14/05	3/7/05
HS65	2/14/05	3/3/05
HS72	2/15/05	3/7/05
HS74	2/15/05	3/7/05
HS85	2/16/05	3/14/05
HS86	2/16/05	3/14/05
HT02	2/15 - 17/05	3/3/05
HT20	2/17/05	3/14/05
HT22	2/17/05	3/14/05
HT27	2/18/05	3/16/05
HT28	2/18/05	3/16/05
HY13	4/8/05	4/22/05
HY59	2/14 – 2/15/05	4/11/05
HY59-II		4/22/05
HY59-III		4/27/05
IA51	5/2 – 5/3/05	5/25/05
IA52	5/2 – 5/3/05	5/25/05
IC83	6/2/05	6/17/05

Polychlorinated biphenyl (PCB) analyses were performed by EPA Method 8082. Diesel range petroleum hydrocarbons (TPH-D) analyses were performed by WA DOE method NWTPH-Dx. Soil Total Organic Carbon (TOC) analyses were performed by Plumb, 1981 and water TOC analyses were performed by EPA method 415.1. Analyses were performed by Analytical Resources, Inc. in Tukwila, Washington.

One laboratory batch per matrix for PCB, TPH-D and TOC was selected for full validation. A summary validation was performed on the remaining batches for these analyses. Validation was performed by Cari Sayler. A sample cross reference, indicating the requested analysis and validation type performed is provided in section 2.0 of this report. Data qualifiers are summarized in section 6.0 of this report.

2.0 Analytical Schedule

PCB, TPH-D, and TOC analyses were performed on the samples as indicated below:

In the following table, F indicates that a full validation was performed, S indicates that a summary validation was performed, and NA indicates that the analysis was not requested/performed.

Sample ID	Lab ID	Matrix	PCB	TPH-D	TOC
P2ST-SB-PP048-0020	HS63A	Soil	F	F	NA
P2ST-SB-PP048-0040	HS63B	Soil	F	F	NA
P2ST-SB-PP048-0060	HS63C	Soil	F	F	NA
P2ST-SB-PP048-0080	HS63D	Soil	F	F	NA
P2ST-SB-PP048-0100	HS63E	Soil	F	F	NA
P2ST-SB-PP048-0120	HS63F	Soil	F	F	NA
P2ST-SB-PP048-0140	HS63G	Soil	F	F	NA
P2ST-SB-PP048-0160	HS63H	Soil	F	F	NA
P2ST-SB-PP061-0080	HS63S	Soil	F	F	NA
P2ST-SB-PP061-0100	HS63T	Soil	F	F	NA
P2ST-SB-PP061-0120	HS63U	Soil	F	F	NA
P2ST-SB-PP061-0140	HS63V	Soil	F	F	NA
P2ST-SB-PP061-0160	HS63W	Soil	F	F	NA
P2ST-SB-PP062-0080	HS63I	Soil	F	F	NA
P2ST-SB-PP062-0100	HS63J	Soil	F	F	NA
P2ST-SB-PP062-0120	HS63K	Soil	F	F	NA
P2ST-SB-PP062-0140	HS63L	Soil	F	F	NA
P2ST-SB-PP062-0160	HS63M	Soil	F	F	NA
P2ST-SB-PP063-0080	HS63N	Soil	F	F	NA
P2ST-SB-PP063-0100	HS63O	Soil	F	F	NA
P2ST-SB-PP063-0120	HS63P	Soil	F	F	NA
P2ST-SB-PP063-0140	HS63Q	Soil	F	F	NA
P2ST-SB-PP063-0160	HS63R	Soil	F	F	NA
P2ST-SB-PP029-0080	HS64P	Soil	S	S	NA
P2ST-SB-PP029-0100	HS64Q	Soil	S	S	NA
P2ST-SB-PP029-0120	HS64R	Soil	S	S	NA
P2ST-SB-PP029-0140	HS64S	Soil	S	S	NA
P2ST-SB-PP029-0160	HS64T	Soil	S	S	NA
P2ST-SB-PP031-0080	HS64A	Soil	S	S	F
P2ST-SB-PP031-0100	HS64B	Soil	S	S	NA
P2ST-SB-PP031-0120	HS64C	Soil	S	S	NA
P2ST-SB-PP031-0140	HS64D	Soil	S	S	NA
P2ST-SB-PP031-0160	HS64E	Soil	S	S	NA
P2ST-SB-PP032-0080	HS64F	Soil	S	S	NA
P2ST-SB-PP032-0100	HS64G	Soil	S	S	NA
P2ST-SB-PP032-0120	HS64H	Soil	S	S	NA
P2ST-SB-PP032-0140	HS64I	Soil	S	S	NA
P2ST-SB-PP032-0160	HS64J	Soil	S	S	NA
P2ST-SB-PP033-0080	HS64K	Soil	S	S	NA
P2ST-SB-PP033-0100	HS64L	Soil	S	S	NA
P2ST-SB-PP033-0120	HS64M	Soil	S	S	NA

Sample ID	Lab ID	Matrix	PCB	TPH-D	TOC
P2ST-SB-PP033-0140	HS64N	Soil	S	S	NA
P2ST-SB-PP033-0160	HS64O	Soil	S	S	NA
P2ST-SB-PP030-0080	HS65A	Soil	S	S	NA
P2ST-SB-PP030-0100	HS65B	Soil	S	S	NA
P2ST-SB-PP030-0120	HS65C	Soil	S	S	NA
P2ST-SB-PP030-0140	HS65D	Soil	S	S	NA
P2ST-SB-PP030-0160	HS65E	Soil	S	S	NA
P2ST-SB-PP050-0020	HS65F	Soil	S	S	NA
P2ST-SB-PP050-0040	HS65G	Soil	S	S	NA
P2ST-SB-PP050-0060	HS65H	Soil	S	S	NA
P2ST-SB-PP050-0080	HS65I	Soil	S	S	NA
P2ST-SB-PP050-0100	HS65J	Soil	S	S	NA
P2ST-SB-PP050-0120	HS65K	Soil	S	S	NA
P2ST-SB-PP050-0140	HS65L	Soil	S	S	NA
P2ST-SB-PP050-0160	HS65M	Soil	S	S	NA
P2ST-GW-PP060-0000	HS72F	Water	F	F	F
P2ST-SB-PP060-0080	HS72A	Soil	S	S	NA
P2ST-SB-PP060-0100	HS72B	Soil	S	S	NA
P2ST-SB-PP060-0120	HS72C	Soil	S	S	NA
P2ST-SB-PP060-0140	HS72D	Soil	S	S	NA
P2ST-SB-PP060-0160	HS72E	Soil	S	S	NA
P2ST-SB-PP049-0020	HS74A	Soil	S	S	NA
P2ST-SB-PP049-0040	HS74B	Soil	S	S	NA
P2ST-SB-PP049-0060	HS74C	Soil	S	S	NA
P2ST-SB-PP049-0080	HS74D	Soil	S	S	NA
P2ST-SB-PP049-0100	HS74E	Soil	S	S	NA
P2ST-SB-PP049-0120	HS74F	Soil	S	S	NA
P2ST-SB-PP049-0140	HS74G	Soil	S	S	NA
P2ST-SB-PP049-0160	HS74H	Soil	S	S	NA
P2ST-SB-MWJF04A-0080	HS85A	Soil	S	S	NA
P2ST-SB-MWJF04A-0100	HS85B	Soil	S	S	S
P2ST-SB-MWJF04A-0120	HS85C	Soil	S	S	NA
P2ST-SB-MWJF04A-0140	HS85D	Soil	S	S	NA
P2ST-SB-MWJF04A-0160	HS85E	Soil	S	S	NA
P2ST-SB-MWJF04A-0180	HS85F	Soil	S	S	NA
P2ST-SB-MW006AR-0080	HS86G	Soil	S	S	NA
P2ST-SB-MW006AR-0100	HS86H	Soil	S	S	NA
P2ST-SB-MW006AR-0120	HS86I	Soil	S	S	NA
P2ST-SB-MW006AR-0140	HS86J	Soil	S	S	NA
P2ST-SB-MW006AR-0160	HS86K	Soil	S	S	NA
P2ST-SB-MW007AR-0080	HS86A	Soil	S	S	NA
P2ST-SB-MW007AR-0100	HS86B	Soil	S	S	NA
P2ST-SB-MW007AR-0120	HS86C	Soil	S	S	NA
P2ST-SB-MW007AR-0140	HS86D	Soil	S	S	NA
P2ST-SB-MW007AR-0160	HS86E	Soil	S	S	NA
P2ST-WT-MW006AR-2080	HS86F	Water	S	NA	NA
P2ST-GR-CB001-0000	HT02A	Soil	S	NA	NA
P2ST-GR-CB002-0000	HT02B	Soil	S	NA	NA
P2ST-GR-CB003-0000	HT02C	Soil	S	NA	NA
P2ST-GR-CB004-0000	HT02D	Soil	S	NA	NA
P2ST-GR-CB005-0000	HT02E	Soil	S	NA	NA
P2ST-GR-CB006-0000	HT02F	Soil	S	NA	NA
P2ST-GR-CB007-0000	HT02G	Soil	S	NA	NA
P2ST-GR-CB008-0000	HT02H	Soil	S	NA	NA
P2ST-GW-MW004A-0000	HT20B	Water	S	S	S
P2ST-GW-MW030A-0000	HT20C	Water	S	S	S
P2ST-GW-MW034A-0000	HT20A	Water	S	S	S
P2ST-GW-MWJF01A-0000	HT22A	Water	S	S	S

Sample ID	Lab ID	Matrix	PCB	TPH-D	TOC
P2ST-GW-MWJF01A-1000	HT22B	Water	S	S	S
P2ST-GW-MW006AR-0000	HT27B	Water	S	S	S
P2ST-GW-MW007AR-0000	HT27A	Water	S	S	S
P2ST-GW-MWJF04A-0000	HT28A	Water	S	S	S
P2ST-GR-CB009-0000	HY13A	Soil	S	NA	NA
P2ST-GR-CB010-0000	HY13B	Soil	S	S	NA
P2ST-GR-CB011-0000	HY13C	Soil	S	S	NA
P2ST-GR-CB012-0000	HY13D	Soil	S	S	NA
P2ST-SB-PP047-0020	HW59A	Soil	S	S	NA
P2ST-SB-PP047-0040	HW59B	Soil	S	S	NA
P2ST-SB-PP047-0060	HW59C	Soil	S	S	NA
P2ST-SB-PP052-0020	HW59D	Soil	S	NA	NA
P2ST-SB-PP052-0040	HW59E	Soil	S	NA	NA
P2ST-SB-PP053-0020	HW59F	Soil	S	S	NA
P2ST-SB-PP053-0040	HW59G	Soil	S	S	NA
P2ST-SB-PP053-0060	HW59H	Soil	S	S	NA
P2ST-SB-PP053-0080	HW59I	Soil	S	S	NA
P2ST-SB-PP053-0100	HW59J	Soil	S	S	NA
P2ST-SB-PP053-0120	HW59K	Soil	S	S	NA
P2SC-GR-SD001-000	IA51A	Soil	S	S	NA
P2SC-GR-SD003-000	IA51B	Soil	S	S	NA
P2SC-GR-SD002-000	IA51C	Soil	S	S	NA
P2SC-GR-SD004-000	IA51D	Soil	S	S	NA
P2SC-GR-SD005-000	IA52A	Soil	S	S	NA
P2SC-GR-SD006-000	IC83A	Soil	S	S	NA

Sample number transcription: Sample IDs in the electronic data deliverable (EDD) were compared to the chain of custody for each sample and field duplicate. All sample IDs matched the chain of custody.

Requested analyses: Analyses performed for each sample and field duplicate were compared to the chain of custody. No discrepancies were noted.

3.0 PCB Analyses

Quality control analysis frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: method blank, laboratory control sample (LCS), matrix spike (MS), and either MS duplicate (MSD) or laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample.

Twelve of the sixteen batches included a method blank, LCS, MS, MSD, and appropriate surrogates. MS/MSD samples were not extracted with sample batches PB0221B-01, PB0223A-02, PB0413A-01 or PB0414A-01. A frequency of 1/20 was met and no qualifiers are assigned.

Holding times: Refrigerated soil samples must be extracted within 14 days of collection. Frozen soil samples must be extracted within 1 year of collection. Refrigerated water samples must be extracted within 7 days of collection. Extracts must be analyzed within 40 days of extraction. These holding times were met.

Instrument calibration: Data usability criteria for calibrations include minimum correlation coefficients of 0.990 or maximum RSDs of ±20% for each initial

calibration, and maximum % differences of ±25% for each continuing calibration. All initial calibration compound RSDs were within 20%. Continuing calibration % differences were within ±25% with the following exceptions.

The % difference for the first (-26.2%), second (-25.7%) and fourth (-28.7%) aroclor 1254 quantitation peaks on the ZB5 column of the 3/2/05 04:07 continuing calibration slightly exceeded the 25% criteria. % Differences on the ZB35 column were within limits and no qualifiers are assigned.

Surrogate retention times: Surrogate retention times are monitored to measure instrument performance. Retention times of TCMX in each sample and standard must be within ±0.05 minutes of the average TCMX retention time in the initial calibration. Retention times of DCBP in each sample and standard must be within ±0.10 minutes of the average DCBP retention time in the initial calibration. These criteria were met.

Laboratory and rinsate blank results: Criteria for blanks are that analyte concentrations must be below the RL, or below 5% of the lowest associated sample concentration. This criteria was met in the method blanks and in the rinsate blank (MW006AR-2080).

Surrogate recoveries: Surrogate recoveries were within the QAPP specified limits of 60-125% for soil and 70-120% for water with the following exceptions:

Sample ID	Matrix	DCBP % Recovery	TCMX % Recovery	Average % Recovery
P2ST-SB-PP048-0020	Soil	126	82.5	104.3
P2ST-SB-PP033-0080	Soil	104	46.2	75.1
P2ST-SB-PP033-0140	Soil	73.2	48.8	61
P2ST-SB-PP033-0160	Soil	87.2	55.8	71.5
P2ST-SB-PP060-0100	Soil	146	121	133
P2SC-GR-SD002-0000	Soil	145	109	127
P2ST-GW-MW004A-0000	Water	101	52	76.5
P2ST-GW-MW030A-0000	Water	89	56.8	72.9
P2ST-GW-MWJF01A-0000	Water	101	53.5	77.3
P2ST-GW-MWJF01A-1000	Water	96.8	49.2	73
P2ST-GW-MW007AR-0000	Water	114	58.2	86.1
P2ST-GW-MW006AR-0000	Water	98.5	51	74.8
P2ST-GW-MWJF04A-0000	Water	94.8	42	68.4
P2ST-GR-CB005-0000	Water	110	35.8	72.9

In each case, the recovery is within the laboratory limit and only one of the two surrogate recoveries was outside of the QAPP limits. No qualifiers are assigned.

Surrogates were not recovered or were outside of limits in samples P2ST-GR-CB009-0000, P2ST-GR-CB010-0000 RE, P2ST-GR-CB012-0000 and P2SC-GR-SD005-0000 due to dilution. No qualifiers are necessary.

LCS recoveries: LCS recoveries were within the QAPP specified limits of 60-125% for soil and 70-120% for water with the following exception:

Lab Batch	Lab ID	Analyte	Recovery (%)	Control Limit
PB0223B-01	022405LCSD	Aroclor 1016	51.6	60 – 125
PB0607A-01	060705LCS	Aroclor 1260	127	60 – 125

This recoveries are within the laboratory limits, the associated LCS or LCSD recoveries are within limits and no qualifiers are assigned.

MS recoveries: Concentrations of aroclor 1260 in P2ST-GR-CB008-0000 MS and P2ST-GR-CB008-0000 MSD exceeded the calibration range and values are not reliable. Matrix effects on accuracy could not be evaluated for this sample.

Recoveries of Aroclor 1016 (164 and 172%) and Aroclor 1260 (167 and 177%) in P2SC-GR-SD005-0000 MS and MSD were elevated due to high levels of Aroclor 1254 detected in the sample. Recoveries of Aroclor 1016 in the MS (144%) and Aroclor 1260 in the MS and MSD (200 and 200%) in P2SC-GR-SD006-0000 MS and MSD were elevated due to high levels of Aroclor 1254 detected in the sample. Recoveries of Aroclor 1016 and Aroclor 1260 in P2SC-GR-SD003-0000 MS and MSD were not reported due to high levels of Aroclor 1254 detected in the sample. Aroclor 1016 and 1260 were not detected in the associated samples and no qualifiers are assigned.

Concentrations of aroclor 1260 in P2ST-GR-CB008-0000 MS and P2ST-GR-CB008-0000 MSD exceeded the calibration range and values are not reliable. Matrix effects on accuracy could not be evaluated for this sample.

All remaining MS and MSD recoveries were within the QAPP specified limits of 60-125% for soil and 70-120% for water

MS/MSD RPDs: Concentrations of Aroclor 1260 in P2ST-GR-CB008-0000MS and P2ST-GR-CB008-0000MSD exceeded the calibration range and values are not reliable. Matrix effects on precision could not be evaluated for this sample.

Remaining MS/MSD RPDs were within the water 20% and soil 25% QAPP specified limits with two exceptions.

QC ID	Analyte	RPD	Lab Limit	QAPP Limit
P2ST-SB-PP060-0080MSD	Aroclor 1016	32.3	30	25
P2ST-SB-PP060-0080MSD	Aroclor 1260	26.9	30	25

Aroclors were not detected in sample P2ST-SB-PP060-0080, and no qualifiers are required.

Field duplicate RPDs: No PCBs were detected in sample GW-MWJF01A-0000 or its duplicate GW-MWJF01A-1000.

Internal standard areas: Internal standard area counts in each sample must not vary by more than a factor of 2 from the associated 12-hour standard (50 – 200%). Internal standard area counts from SDG HS63 (soils) and the water sample in SDG HS72 were reviewed. Area counts were acceptable with the following exceptions:

Sample ID	Column	Analyte	Area in Sample	Area from Standard	% of Standard
P2ST-SB-PP048-0020	1	Heptachlorobiphenyl	18624146	49071252	38.0%
P2ST-SB-PP048-0060	1	Heptachlorobiphenyl	21214595	49071252	43.2%
P2ST-SB-PP061-0080	1	Bromonitrobenzene	NR	85190086	0%

P2ST-SB-PP061-0100	1	Bromonitrobenzene	NR	85190086	0%
P2ST-SB-PP061-0120	1	Bromonitrobenzene	NR	85190086	0%
P2ST-SB-PP061-0160	2	Bromonitrobenzene	36922350	16335434	226%

For samples P2ST-SB-PP048-0020 and P2ST-SB-PP048-0060, DBCP recoveries were not be quantitated from this column. Aroclors associated with this internal standard were not quantitated from this column, and no qualifiers were required.

For samples P2ST-SB-PP061-0080, P2ST-SB-PP061-0100, and P2ST-SB-PP061-0120, bromonitrobenzene was not reported due to interferences. TCMX recovery could not be quantitated from this column. Aroclors associated with this internal standard were not detected, and no qualifiers were required.

For sample P2ST-SB-PP061-0160, TCMX recovery was not quantitated from this column. Aroclors associated with this internal standard were not detected, and no qualifiers were required.

Compound identifications: Chromatograms and quantitation reports from SDG HS63 (soils) and the water sample in SDG HS72 were reviewed for accuracy of compound identifications. No errors were noted. Additionally, the determination of halowax interferences in sample P2ST-SB-PP052-0020 was reviewed and confirmed.

Compound quantitations: Concentrations of Aroclor 1260 and surrogate recoveries for each sample in SDG HS63 and the water sample in SDG HS72 were recalculated to verify compound quantitations. No errors were noted.

Multiple reported results: Unless quality control results warrant the rejection of one result, multiple reported results are evaluated according to the following guidelines

(1) If both results are non-detects, the lower reporting limit was selected.
(2) If one result was not detected and the other detected, the detection was selected.
(3) If both results were detections, the following additional criteria were applied:
    (a) If one result was off-scale and one was on-scale, the on-scale result was selected.
    (b) If associated QC results indicated high bias, the lower concentration result was selected.
    (c) If associated QC results indicated no, low, or mixed biases, the higher concentration result was selected.

This approach is conservative, and is considered most protective of the environment. The results not selected as the best result to report are qualified R1, rejected due to the availability of better results.

Laboratory qualifiers: The concentration of Aroclor 1260 in sample P2ST-SB-PP050-0020 and Aroclor 1254 in sample P2ST-GR-CB009-0000 were flagged P to indicate a dual column concentration RPD exceeding 40%. The P-flagged results are qualified as estimated. Various results are flagged Y to indicate elevated reporting limits. These results are qualified "UY" to clarify that the aroclor was not detected.

Reporting limits: QAPP specified reporting limit (RL) requirements for PCBs are 33-67 µg/kg for soil samples and 1 ug/L for water samples. RLs were met for water samples. For soil samples, the RLs of some aroclors were elevated due to sample

dilutions, reduced sample size, or analytical interferences. In most cases, the sample also contained detected aroclors and the impact on the total PCB value is minimal. For the following samples, the reporting limits were elevated due to matrix interference, and no other aroclors were detected.

Sample ID	Analyte	Reporting Limit (ug/Kg)
P2ST-SB-PP032-0160	Aroclor 1260	88
P2ST-SB-PP033-0080	Aroclor 1260	220
P2ST-SB-PP033-0100	Aroclor 1221	88
P2ST-SB-PP033-0100	Aroclor 1232	130
P2ST-SB-PP033-0100	Aroclor 1242	88
P2ST-SB-PP033-0100	Aroclor 1254	130
P2ST-SB-PP033-0100	Aroclor 1260	220
The initial analysis of P2ST-SB-PP052-0020	All	580-4100

Sample HW59D was re-extracted and analyzed with a longer run to separate interferences and obtain better reporting limits. The presence of Aroclor 1260 was confirmed. Interferences were still present, significantly elevating the reporting limit for Aroclor 1254 (1600 ug/Kg). The extract was cleaned with silica gel and analyzed a third time. A reporting limit of 590 ug/Kg was achieved for Aroclor 1254. It was also determined and confirmed with a standard that the interfering peaks represented Halowax. No qualifiers are assigned on the basis of reporting limits.

Overall assessment: Documentation was found to be clear and complete. No calculation, identification, or transcription errors were noted. Calibration data demonstrate acceptable instrument performance. Multiple analysis results were reduced to the most reliable value. Dual column variability resulted in some estimated concentrations.

PCB data, as qualified, are acceptable for use.

4.0 Diesel Range Petroleum Hydrocarbon Analysis

Quality Control Analysis Frequencies: The method specifies that the following quality control samples be analyzed one per analytical batch or one per twenty samples, whichever is more frequent: Method blank and laboratory duplicate. In addition, surrogate compounds must be measured in each field and quality control sample. The following QC samples were analyzed:

Matrix	Lab Batch	QC samples
Soil	TD0218D-01	LCS, LCSD, method blank, MS, MSD, laboratory duplicate, and appropriate surrogates
Soil	TD0218E-01	
Soil	TD0221B-01	
Soil	TD0222A-01	
Soil	TD0222C-01	
Soil	TD0225A-02	LCS, LCSD, method blank, laboratory duplicate, and appropriate surrogates
Soil	TD0328A-01	LCS, LCSD, method blank, MS, MSD, and appropriate surrogates

Matrix	Lab Batch	QC samples
Soil	TD0413A-01	LCS, LCSD, method blank, and appropriate surrogates
Soil	TD0516A-01	LCS, LCSD, MS, MSD, method blank, and appropriate surrogates
Soil	TD0503A-03	LCS, LCSD, MS, MSD, method blank, and appropriate surrogates
Soil	TD0606B-01	LCS, LCSD, MS, MSD, method blank, and appropriate surrogates
Water	TD0218B-01	LCS, LCSD, method blank, and appropriate surrogates
Water	TD0222D-01	LCS, LCSD, method blank, MS, MSD, and appropriate surrogates

A 1/20 frequency was met for the laboratory duplicate and no qualifiers are assigned.

Holding times: Refrigerated soil samples must be extracted within 14 days of collection. Frozen soil samples must be extracted within 1 year of collection. Refrigerated water samples must be extracted within 7 days of collection. Extracts must be analyzed within 40 days of extraction. These holding times were met.

Instrument calibration: Method criteria for calibrations include minimum correlation coefficients of 0.990 for initial calibration compounds, maximum % differences of ±15% for each standard within the initial calibration, and maximum % differences of ±25% for each continuing calibration standard. These criteria were met for both soil and water samples.

Laboratory blank results: Criteria for method blanks are that analyte concentrations must be below the PQL, or below 5% of the lowest associated sample concentration. This criteria was met with one exception: Mineral spirits were detected in method blank 021905MB at a concentration of 8.6 mg/kg. Three of the associated samples (P2ST-SB-PP062-0100, P2ST-SB-PP063-0080, and P2ST-SB-PP048-0040) contained mineral spirits at a concentration within 5 times this level. These sample results are qualified "U" and should be considered not detected at the reported concentration.

Surrogate recoveries: The recommended surrogates are 2-fluorobiphenyl and terphenyl or pentacosane. The laboratory utilized o-terphenyl as the surrogate compound. The QAPP control limit for accuracy is 50 to 150% for soils and 60-120 for waters. Surrogate recoveries were within the QAPP limits with the following exceptions:

O-terphenyl were not recovered or were outside of limits in samples P2ST-SB-PP048-0020, P2ST-SB-PP033-0080, P2ST-SB-PP033-0100, P2ST-SB-MW006AR-0120, P2ST-SB-MW006AR-0120 DL, P2ST-SB-MW006AR-0140, P2ST-SB-MW006AR-0140DL, P2SC-GR-SD005-0000, and P2SC-GR-SD006-0000 due to dilution or high concentrations of petroleum hydrocarbons. No qualifiers are necessary.

LCS recoveries: LCS and LCSD recoveries were within the QAPP control limits for accuracy of 50 to 150% for soils and 60-120 for waters.

MS recoveries: MS and MSD recoveries were within the QAPP control limits for accuracy of 50 to 150% for soils and 60-120 for waters with three exceptions:

The recovery of diesel in P2SC-GR-SD003-0000 MSD (182%) exceeded the control limit. Variability between the sample result and matrix spike result likely contributed to this outlier and associated results are not qualified based on accuracy.

The recovery of diesel in P2SC-GR-SD006-0000 MSD (153%) slightly exceeded the control limit. The MS recovery was within limits and no qualifiers are assigned.

The concentration of diesel in P2SC-GR-SD005-0000 exceeded the spike amount by more than four times and MS recovery control limits do not apply. No qualifiers are assigned.

MS/MSD RPDs: QAPP control limit for precision was <35% for soils and <30% for waters. These criteria were met with one exception.

Parent ID	Analyte	RPD
P2SC-GR-SD002-0000	Diesel Range Hydrocarbons	38.7

Positive results in the associated samples are qualified as estimated.

Laboratory duplicate RPDs: QAPP control limit for precision was <35% for soils and <30% for waters. For some of the duplicates, target analyte concentrations were below the reporting limit and variability could not be evaluated. RPDs for all laboratory duplicates containing target analytes are shown below:

Parent ID	Analyte	RPD
P2ST-SB-PP032-0080	Diesel Range Hydrocarbons	155
P2ST-SB-MWJF04A-0180	Diesel Range Hydrocarbons	8.7
P2ST-SB-PP048-0040	Diesel Range Hydrocarbons	21.1
P2ST-SB-PP032-0080	Mineral Spirits	0
P2ST-SB-PP032-0080	Motor Oil	119
P2ST-SB-MWJF04A-0180	Motor Oil	10.9
P2ST-SB-PP048-0040	Motor Oil	28.6
P2ST-SB-PP032-0080	Motor Oil	48
P2ST-SB-PP030-0100	Motor Oil	57.8

The diesel range hydrocarbon result in sample P2ST-SB-PP032-0080 is qualified as estimated. Because 3 of the 4 soil motor oil duplicates exceeded the control limit, all positive soil motor oil results in the March and April batches are estimated due to variability.

Field duplicate RPDs: The RPD for diesel range hydrocarbons between sample GW-MWJF01A-0000 and its duplicate GW-MWJF01A-1000 (3.8%) was within the QAPP limit of <30%.

Compound identifications: Chromatograms and quantitation reports from SDG HS63 (soils) and the water sample in SDG HS72 were reviewed for accuracy of compound identifications. No errors were noted.

Compound quantitations: Concentrations of diesel range hydrocarbons and o-terphenyl for each sample and QC sample in SDG HS63 and the water sample and water QC samples in SDG HS72 were recalculated to verify compound quantitations. No errors were noted in the sample quantitations. However the concentration of

diesel range hydrocarbons in the HS63 LCSD was incorrect because it was quantitated against the wrong standard. The laboratory was contacted and the appropriate pages resubmitted. The data was validated based on the correct recoveries and no further action was required.

Multiple reported results: Multiple reported results are qualified according to the guidelines in section 3.0 above. The results not selected as the best result to report are qualified R1, rejected due to the availability of better results.

Reporting limits: QAPP specified reporting limit (RL) requirements for TPH are 25 mg/kg for soil samples and 0.5 mg/L for water samples. RLs were met for water samples. For soil samples, the RLs of some hydrocarbon ranges were elevated due to sample dilution or reduced sample size. In most cases, the sample also contained detected hydrocarbons and the impact is minimal. For sample P2ST-SB-MWJF04A-0140, the reporting limits were elevated to 32 mg/kg for diesel and mineral spirits and to 64 mg/kg for motor oil due to a reduced sample size. No qualifiers are assigned on the basis of reporting limits.

Overall Assessment: Documentation was found to be clear and complete. No identification or transcription errors were noted. One minor quantitation error in a QC sample was noted and corrected. Calibration data indicate acceptable instrument performance. Multiple analysis results were reduced to the most reliable value. Quality control results demonstrate acceptable levels of accuracy. Several diesel results and most positive motor oil results were estimated due to variability. Three mineral spirits reporting limits were elevated due to blank contamination.

Diesel range hydrocarbon data, as qualified, are acceptable for use.

5.0 General Chemistry Analyses

Quality control analysis frequencies: The following quality control samples were analyzed in each batch:

Preparation date	Matrix	QC samples
2/15/05	Water	Method blank, and SRM
2/21/05	Water	Method blank, SRM, MS and laboratory duplicate
2/22/05	Water	Method blank, and SRM
2/16/05	Soil	Method blank, LCS, SRM, MS and laboratory triplicate
2/25/05	Soil	Method blank, LCS, SRM, MS and laboratory triplicate

Quality control samples were adequate to evaluate precision and accuracy.

Holding times: Refrigerated soil samples must be analyzed within 14 days of collection. Frozen soil samples must be analyzed within 6 months of collection. Refrigerated water samples must be analyzed within 28 days of collection. These holding times were met.

Instrument calibration: Criteria of minimum correlation coefficients of 0.990 for initial calibration compounds and maximum % differences of ±10% for each continuing calibration standard were used to evaluate instrument calibration. These criteria were met for both soil and water samples.

Laboratory blank results: Criteria for method blanks are that analyte concentrations must be below the PQL, or below 10% of the lowest associated sample concentration. This criterion was met for all method blanks.

LCS and SRM recoveries: LCS and SRM recoveries were within the QAPP control limit for accuracy for both soils (75-125%) and waters (80-120%).

MS recoveries: MS recoveries were within the QAPP control limit for accuracy for soils (75-125%).

Laboratory duplicate and triplicate results: The RSD for TOC in P2ST-SB-PP031-0080 (45.6%) exceeded the QAPP control limit for precision of 25%. This sample result is qualified as estimated.

Field duplicate RPDs: The RPD for TOC between sample GW-MWJF01A-0000 and its duplicate GW-MWJF01A-1000 (0.0%) was within the QAPP limit of ±30%.

Compound quantitations: Concentrations of TOC for the sample and QC samples in SDG HS64 and the water sample and water QC samples in SDG HS74 were recalculated to verify compound quantitations. No errors were noted.

Overall Assessment: Documentation was found to be clear and complete. No quantitation or transcription errors were noted. Calibration data indicate acceptable instrument performance. Quality control results demonstrate acceptable levels and accuracy. One result was estimated due to laboratory triplicate variability.

General chemistry data, as qualified, are acceptable for use.

6.0 Qualifier Summary Table

Sample ID	Analyte	Qualifier	Reason
PCB Analysis			
P2ST-GR-CB002-0000	Aroclor 1016	R1	Analysis with lower RL available
P2ST-GR-CB002-0000	Aroclor 1221	R1	Analysis with lower RL available
P2ST-GR-CB002-0000	Aroclor 1232	R1	Analysis with lower RL available
P2ST-GR-CB002-0000	Aroclor 1242	R1	Analysis with higher concentration available
P2ST-GR-CB002-0000	Aroclor 1248	R1	Analysis with lower RL available
P2ST-GR-CB002-0000	Aroclor 1254	R1	Analysis with higher concentration available
P2ST-GR-CB002-0000 RE	Aroclor 1242	R1	Analysis with on-scale result available
P2ST-GR-CB002-0000 RE	Aroclor 1254	R1	Analysis with on-scale result available
P2ST-GR-CB002-0000 RE	Aroclor 1260	R1	Analysis with on-scale result available
P2ST-GR-CB002-0000 RE2	Aroclor 1016	R1	Analysis with lower RL available
P2ST-GR-CB002-0000 RE2	Aroclor 1221	R1	Analysis with lower RL available
P2ST-GR-CB002-0000 RE2	Aroclor 1232	R1	Analysis with lower RL available
P2ST-GR-CB002-0000 RE2	Aroclor 1248	R1	Analysis with lower RL available
P2ST-GR-CB002-0000 RE2	Aroclor 1260	R1	Analysis with higher concentration available
P2ST-GR-CB009-0000	Aroclor 1254	J	Dual Column variability
P2ST-GR-CB010-0000	Aroclor 1248	R1	Analysis with on-scale result available

Sample ID	Analyte	Qualifier	Reason
P2ST-GR-CB010-0000	Aroclor 1254	R1	Analysis with on-scale result available
P2ST-GR-CB010-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-GR-CB010-0000 RE	Aroclor 1016	R1	Analysis with lower RL available
P2ST-GR-CB010-0000 RE	Aroclor 1221	R1	Analysis with lower RL available
P2ST-GR-CB010-0000 RE	Aroclor 1232	R1	Analysis with lower RL available
P2ST-GR-CB010-0000 RE	Aroclor 1242	R1	Analysis with lower RL available
P2ST-GR-CB010-0000 RE	Aroclor 1260	R1	Analysis with same result available
P2ST-GR-CB011-0000	Aroclor 1248	R1	Analysis with on-scale result available
P2ST-GR-CB011-0000	Aroclor 1254	R1	Analysis with on-scale result available
P2ST-GR-CB011-0000 RE	Aroclor 1016	R1	Analysis with lower RL available
P2ST-GR-CB011-0000 RE	Aroclor 1221	R1	Analysis with lower RL available
P2ST-GR-CB011-0000 RE	Aroclor 1232	R1	Analysis with lower RL available
P2ST-GR-CB011-0000 RE	Aroclor 1242	R1	Analysis with lower RL available
P2ST-GR-CB011-0000 RE	Aroclor 1260	R1	Analysis with higher concentration available
P2ST-GR-CB012-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-GR-SD001-0000	Aroclor 1248	UY	Clarification of Y flag.
P2ST-GR-SD006-0000 RE	Aroclor 1016	R1	Analysis with lower RL available
P2ST-GR-SD006-0000 RE	Aroclor 1221	R1	Analysis with lower RL available
P2ST-GR-SD006-0000 RE	Aroclor 1232	R1	Analysis with lower RL available
P2ST-GR-SD006-0000 RE	Aroclor 1242	R1	Analysis with lower RL available
P2ST-GR-SD006-0000 RE	Aroclor 1248	R1	Analysis with lower RL available
P2ST-GR-SD006-0000	Aroclor 1254	R1	Analysis with on-scale result available
P2ST-GR-SD006-0000 RE	Aroclor 1260	R1	Analysis with lower RL available
P2ST-GW-MW004A-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MW004A-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MW004A-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MW004A-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1254	UY	Clarification of Y flag
P2ST-GW-MW006AR-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1254	UY	Clarification of Y flag
P2ST-GW-MW007AR-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-GW-MW030A-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MW030A-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MW030A-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1221	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1254	UY	Clarification of Y flag
P2ST-GW-MW034A-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-GW-MWJF01A-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MWJF01A-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MWJF01A-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MWJF01A-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MWJF01A-0000	Aroclor 1254	UY	Clarification of Y flag
P2ST-GW-MWJF01A-1000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MWJF01A-1000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MWJF01A-1000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MWJF01A-1000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MWJF01A-1000	Aroclor 1254	UY	Clarification of Y flag
P2ST-GW-MWJF04A-0000	Aroclor 1016	UY	Clarification of Y flag
P2ST-GW-MWJF04A-0000	Aroclor 1232	UY	Clarification of Y flag
P2ST-GW-MWJF04A-0000	Aroclor 1242	UY	Clarification of Y flag
P2ST-GW-MWJF04A-0000	Aroclor 1248	UY	Clarification of Y flag
P2ST-GW-MWJF04A-0000	Aroclor 1260	UY	Clarification of Y flag
P2ST-SB-MW006AR-0080	Aroclor 1254	UY	Clarification of Y flag

Sample ID	Analyte	Qualifier	Reason
P2ST-SB-MW006AR-0100	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-MW006AR-0120	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-MW006AR-0140	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-MW006AR-0160	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP032-0160	Aroclor 1260	UY	Clarification of Y flag
P2ST-SB-PP033-0080	Aroclor 1260	UY	Clarification of Y flag
P2ST-SB-PP033-0100	Aroclor 1221	UY	Clarification of Y flag
P2ST-SB-PP033-0100	Aroclor 1232	UY	Clarification of Y flag
P2ST-SB-PP033-0100	Aroclor 1242	UY	Clarification of Y flag
P2ST-SB-PP033-0100	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP033-0100	Aroclor 1260	UY	Clarification of Y flag
P2ST-SB-PP048-0020	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP049-0020	Aroclor 1260	UY	Clarification of Y flag
P2ST-SB-PP050-0020	Aroclor 1260	J	Dual Column variability
P2ST-SB-PP050-0040	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP050-0060	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP050-0100	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP050-0100	Aroclor 1260	R1	Analysis with on-scale result available
P2ST-SB-PP050-0100 RE	Aroclor 1016	R1	Analysis with lower RL available
P2ST-SB-PP050-0100 RE	Aroclor 1221	R1	Analysis with lower RL available
P2ST-SB-PP050-0100 RE	Aroclor 1232	R1	Analysis with lower RL available
P2ST-SB-PP050-0100 RE	Aroclor 1242	R1	Analysis with lower RL available
P2ST-SB-PP050-0100 RE	Aroclor 1248	R1	Analysis with lower RL available
P2ST-SB-PP050-0100 RE	Aroclor 1254	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1016	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1221	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1232	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1242	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1248	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1254	R1	Analysis with lower RL available
P2ST-SB-PP052-0020	Aroclor 1260	R1	Analysis with detected result available
P2ST-SB-PP052-0020 RE	Aroclor 1016	R1	Analysis with same result available
P2ST-SB-PP052-0020 RE	Aroclor 1221	R1	Analysis with same result available
P2ST-SB-PP052-0020 RE	Aroclor 1232	R1	Analysis with same result available
P2ST-SB-PP052-0020 RE	Aroclor 1242	R1	Analysis with same result available
P2ST-SB-PP052-0020 RE	Aroclor 1248	R1	Analysis with same result available
P2ST-SB-PP052-0020 RE	Aroclor 1254	R1	Analysis with lower RL available
P2ST-SB-PP052-0020 RE2	Aroclor 1254	UY	Clarification of Y flag
P2ST-SB-PP052-0020 RE2	Aroclor 1260	R1	Analysis with detected result available
P2ST-SB-PP063-0080	Aroclor 1254	UY	Clarification of Y flag
TPH-D Analysis			
P2ST-GR-CB010-0000	Motor Oil	J	Laboratory duplicate variability
P2ST-GR-CB011-0000	Motor Oil	J	Laboratory duplicate variability
P2ST-GR-CB012-0000	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW006AR-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW006AR-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW006AR-0120	Diesel Range Hydrocarbons	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0120	Mineral Spirits	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0120	Motor Oil	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0120 RE	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW006AR-0140	Diesel Range Hydrocarbons	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0140	Mineral Spirits	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0140	Motor Oil	R1	Analysis with on-scale result available
P2ST-SB-MW006AR-0140 RE	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW006AR-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MW007AR-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MWJF04A-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MWJF04A-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MWJF04A-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-MWJF04A-0180	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP029-0080	Motor Oil	J	Laboratory duplicate variability

Sample ID	Analyte	Qualifier	Reason
P2ST-SB-PP029-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP029-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP030-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP030-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP030-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP031-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP031-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP031-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP032-0080	Diesel Range Hydrocarbons	R1	Analysis with higher concentration available
P2ST-SB-PP032-0080	Mineral Spirits	R1	Analysis with same result available
P2ST-SB-PP032-0080	Motor Oil	R1	Analysis with higher concentration available
P2ST-SB-PP032-0080 RE	Diesel Range Hydrocarbons	J	Laboratory duplicate variability
P2ST-SB-PP032-0080 RE	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP032-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP032-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP032-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP033-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP033-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP033-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP033-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP033-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP047-0020	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP048-0020	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP048-0040	Mineral Spirits	U	Blank contamination
P2ST-SB-PP048-0040	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP048-0060	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP048-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP048-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP049-0020	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP049-0040	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP049-0060	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP049-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP050-0020	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP050-0040	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP050-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP050-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP053-0020	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP060-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP060-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP061-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP061-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP062-0100	Mineral Spirits	U	Blank contamination
P2ST-SB-PP062-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP062-0140	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP062-0160	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP063-0080	Mineral Spirits	U	Blank contamination
P2ST-SB-PP063-0080	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP063-0100	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP063-0120	Motor Oil	J	Laboratory duplicate variability
P2ST-SB-PP063-0160	Motor Oil	J	Laboratory duplicate variability
P2SC-GR-SD001-0000	Diesel Motor Oil	J	Matrix spike duplicate variability
P2SC-GR-SD002-0000	Diesel Motor Oil	J	Matrix spike duplicate variability
P2SC-GR-SD003-0000	Diesel Motor Oil	J	Matrix spike duplicate variability
P2SC-GR-SD004-0000	Diesel Motor Oil	J	Matrix spike duplicate variability
General Chemistry Analyses			
P2ST-SB-PP031-0080	Total Organic Carbon	J	Laboratory duplicate variability

7.0 Abbreviations and Definitions

DV Qualifier	Definition
U	The material was analyzed for, but was not detected above the level of the associated value.
UY	The reporting limit was elevated due to interferences. The material was analyzed for, but was not detected above the level of he associated value.
J	The analyte was positively identified. The associated numerical value is the approximate concentration of the analyte in the sample.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
UJ	The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.
R	The sample result is rejected. The presence or absence of the analyte cannot be verified and data are not usable.
R1	This sample result has been rejected in favor of a more accurate and/or precise result. The other result should be used.

Abbreviation	Definition
DV	Data validation
LCS	Laboratory control sample
MS	Matrix spike
MSD	Matrix spike duplicate
RPD	Relative percent difference
RSD	Relative standard deviations
Surr	Surrogate

8.0 References

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